PUBLIC WORKS

Founded in 1896

Devoted to the interests of the engineers and technical officials of the cities, counties and states

VOL. 72. NO. 6

A. PRESCOTT FOLWELL, Editor

JUNE CONTENTS

Published monthly by PUBLIC WORKS JOURNAL CORPORATION

Editorial and advertising offices: 310 East 45th St., New York, N. Y. J. T. MORRIS, *President;* CROXTON MORRIS, *Treasurer. Advertising Manager,* ARTHUR K. AKERS, 310 East 45th St., N. Y. *Advertising representatives,* FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 326 Bulkley Bldg., Cleveland, Ohio. SUBSCRIPTION RATES: United States and Possessions, Canada, Mexico and Cuba, $3.00. All other countries, $4.00 Single Copies, 35 cents each.

The Editor's Page

The A.W.W.A. Convention in Toronto

All water works men will want to attend the 61st convention of the American Water Works Association in Toronto June 22 to 26, not only because it is their convention but also as a demonstration of their feelings towards our northern neighbor in these days of stress. War-time considerations will be discussed in two papers—"Defense of Water Supply Works in Wartime" and "State-Wide Plans for Water Supply Defense"; but most of the program is devoted to peacetime subjects. These include four on use of chlorine, four on steel pipe lining and construction, twelve on finance and management, thirteen on water purification (including three on corrosion prevention); a manufacturers' symposium on "Equipment Available for Emergency Repairs to Distribution Systems" (which might be included under the war-time topics); and a number on other subjects such as regional water supplies, reservoir silting, Federal housing developments, cathodic and other protection of water tanks, experiences in cement lining of water mains, effect of electric grounding on water pipes, cross-connections, plumbing standardization, meter repairs and specifications, and others.

Sessions will be held both morning and afternoon on Monday, Tuesday and Thursday, and on Wednesday morning, beginning at 9:30 in the morning and at 2 in the afternoon. Evenings, Wednesday afternoon and Friday will be devoted to non-technical matters—such as golf and excursions.

At latest reports nearly 1500 had stated their intention to attend the convention. The Canadian Section of the Association, although numbering only a small percentage of the total membership, is one of the most enthusiastic and this will be the fourth convention of the association held within its boundaries—the third in Toronto. For many reasons it should, and we anticipate will, be the most successful.

And How About South America

The A.W.W.A. is not a national association, but an international one. In addition to the active chapter in Canada it has members in more than 25 other countries. About half of them are in Mexico and Central and South America, the other half widely scattered. Would it not be possible, in line with the "Good Neighbor" policy, to increase the membership in the rest of the Americas? Even perhaps to effect a Spanish-American section. Or at least, and as a first step toward a Pan American Water Works Association, an affiliation between our society and associations of water works men in the countries to the south.

The difference in language is, of course, an obstacle that fortunately does not interpose between us and our Canadian brothers, and would perhaps permanently prevent so close an affiliation as we enjoy with them. But we have illustrations of what can be done in spite of that. Next September the fourth Pan-American Highway Congress will be held in Mexico City, where papers will be read, discussed and published in both languages. Even more pertinent is the Pan-American Sanitary Bureau, supported by all the American republics, which publishes a monthly bulletin in English, Spanish and Portugese and includes citizens of fourteen of the republics among its seventeen officers.

Technical men seem to have less difficulty in bridging international boundaries, physical, linguistic and temperamental, than do other classes, and can therefore effect the first ties of mutual respect and confidence between citizens of different nations. We believe therefore that there are possibilities along the lines suggested above and that the A.W.W.A. would be doing a real service to the country, and incidentally to itself, if it would work out some kind of affiliation between water works men of all the Americas.

Opportunities for Water and Sewage Plant Operators at Army Camps

Men competent to serve as superintendents or assistant operators or chemists at water or sewage treatment plants have an opportunity—a duty, in fact—to devote their talents to the country's need by responding to the call for such men just issued by the Quartermaster General of the Army, as detailed on page 54 of this issue.

The Army sewage plants now under design or construction at cantonments and expanded posts are all of the most modern types, with the exception of Fort Devens, which will be natural sand filtration. In many cases complete treatment is provided, which involves standard trickling filters, or high-rate filters, or activated sludge units. Capital investments in these individual plants range up to $250,000. Adequate technically trained supervision and operation will keep these plants in good condition and will result in satisfactory effluents. But lack of such supervision will result in short equipment life, loss of investment, and nuisance conditions about the plant, and erratic or poor quality of effluent, involving endangerment of health of downstream communities and promotion of bad stream conditions. Sanitary engineers owe it to the profession and to their country to do what they can to see that these plants are properly operated.

The salaries are not high—from $3200 for superintendents and $2,000 for chemists down to $1500 for assistant operators—but they are higher than many of the smaller cities are paying for similar services and are intended to be of the approximate range now paid for similar positions in municipal work for men of these qualifications. Consideration should be given to the fact that these men will be called from municipalities where the continuity of their job is assured, and assigned to posts where the position will possibly last for the duration of the present emergency only.

Further information can be had through your local Civil Service Office; or write the U. S. Civil Service Commission or the Quartermaster General, War Dept., Washington, D. C. Or the editors of PUBLIC WORKS will be glad to assist in any way possible.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 69-71

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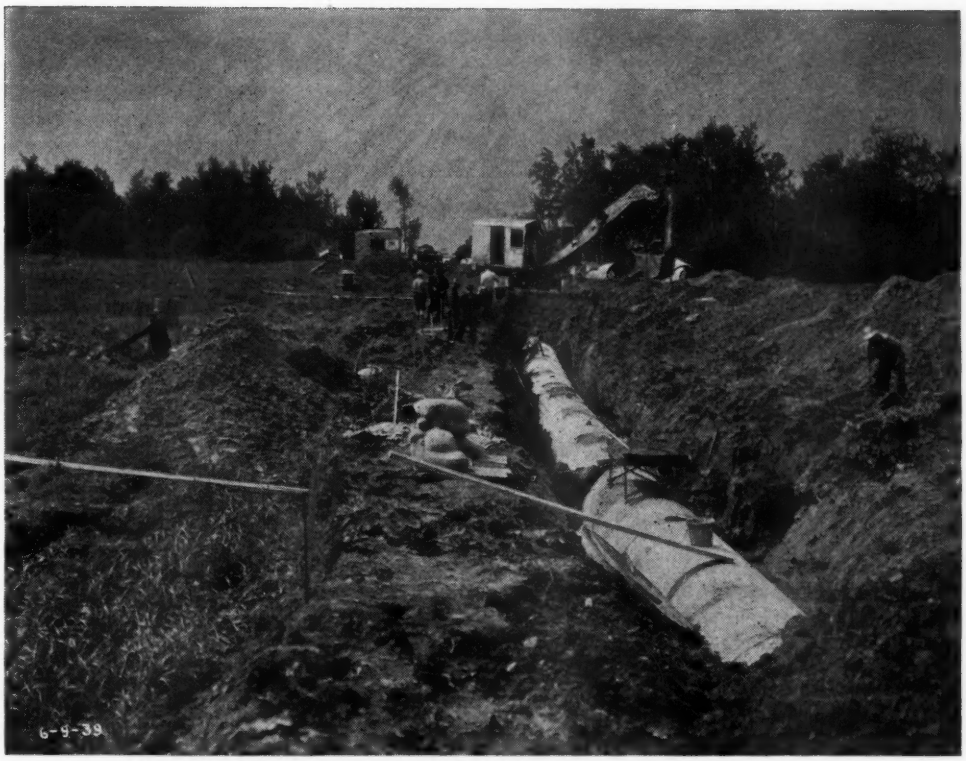


Excavating for and laying 48-inch concrete pipe at Portland.

Seven Miles of Lock Joint Pipe at Portland, Me., Laid in Severe Winter Weather

By HARRY U. FULLER

Engr. Portland Water District

THE Portland, Maine, Water District gets its water from Sebago Lake, which lies seventeen miles north of Portland. As the use of water increases, due to the growth of the distribution system, the supply line from the lake must be augmented in capacity. In 1938 it became necessary to extend toward the lake a second supply main, ten miles of which had previously been laid from Portland northerly, while seven miles of 48 in. pipe still had to be laid to provide the District with two supply mains.

The Public Works Administration was prepared to make a grant of 45% of the cost of the project, and the District took advantage of the opportunity. The contract to manufacture and lay the pipe was awarded to the Lock Joint Pipe Co. in October, 1938. Starting work of this sort at the beginning of a Maine winter required that the work be handled in a way that was different from a job started in the springtime; but being a P.W.A. job, with a Government grant to make work for unemployed men, the job could not be

Harry U. Fuller.

allowed to wait for good weather, but had to be expedited as rapidly as possible.

Accordingly, the construction of a pipe-making yard and the erection of equipment for the manufacture of concrete pipe was started immediately. The month of November was devoted to building the pipe-making plant and obtaining supplies.

The making of pipe was begun in December and finished the following June. The manufacture of pipe during the entire winter was found to be possible with no difficulty experienced in protecting the concrete from the action of frost, the use of canvas covers and sheds and a supply of steam for heating and curing the pipe being found to be entirely satisfactory. After a week of steam curing and protection, the pipes were rolled out on the skids ready for transportation to the trench.

Each piece of pipe weighed seven tons and special trucks were provided with enough strength and tractive power to carry the pipe over the rough and frozen ground and place it alongside the trench. About half of the pipe had been placed at the trench side before the thawing of the ground made it impracticable to use heavily loaded trucks for hauling. A large field, as near as possible to the trench and on a good road, was used to store the rest of the pipe during the time that the frost was coming out of the ground.

Excavating the trench and pipe laying was begun in January, 1939, and finished in August. Building cross-connections with the first supply line and cleaning up the job were finished in September. A part of the contract was the rebuilding of a chlorine house, which was finished before winter weather set in.

The pipe line ran through farms, wood lots and pasture lots in typical rough and rolling New England country. A river, many brooks, and a railroad were crossed. At the river, which, except in time of flood, was only about two feet deep, the pipe was buried under the river by confining the flow of the water to one-half of the channel while the pipe was being placed under the other half. The brooks were carried over the pipe line, and the railroad was crossed on Sunday, when no trains were running.

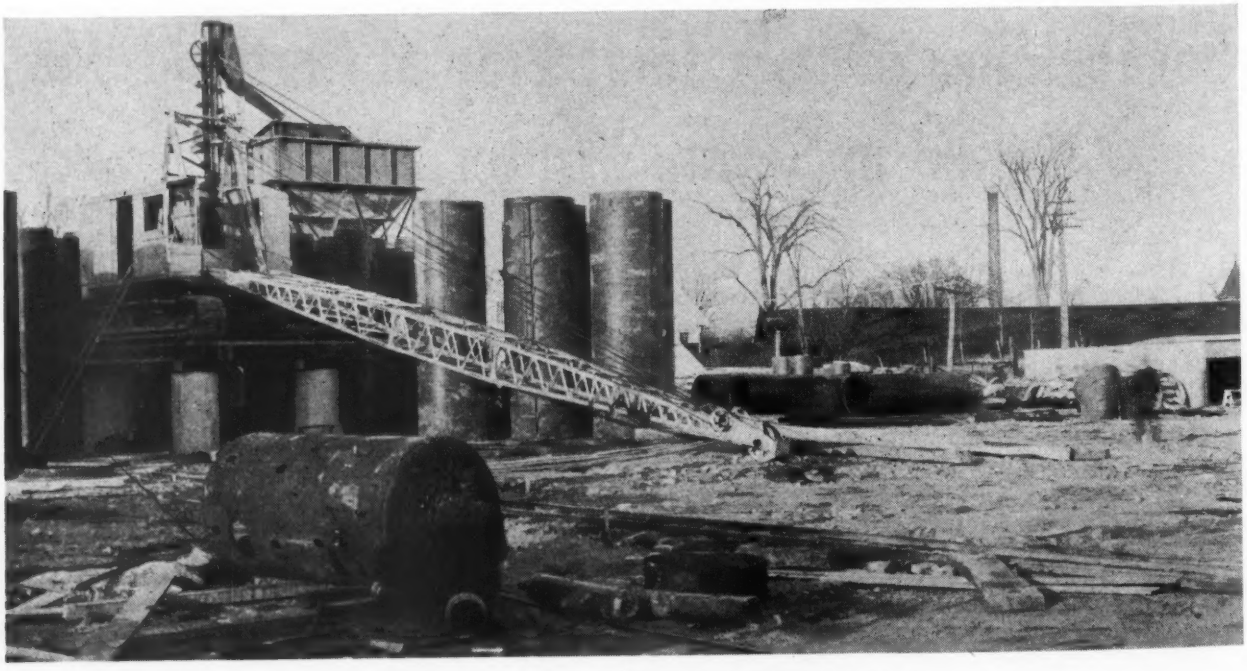
The first step in making a trench was to run a powerful bulldozer along the line as laid out by the survey party and push the ridges into the hollows, making a roadway about 20 feet wide. A power shovel was employed to excavate the trench and lay the pipe.

As soon as a section of trench long enough for one length of pipe had been excavated to the required grade and a suitable bed of fine material placed, the shovel picked up the pipe and placed it in position. The outside of the joint was then filled with mortar and the backfilling completed by hand to a point where the remainder of the backfilling could be placed by a bulldozer.

As fast as the pipe was laid and roughly backfilled, a lead gasket was caulked into the joint from the inside enough to keep ground water out of the pipe. When the pipe laying had been completed, the trench entirely backfilled, and the pipe had settled to its final position, the lead gasket was finally well caulked and the interior of the joint completed by filling the space at the joint with mortar and trowelling it smooth.

Rock and ledge from the excavation were removed to a dump and the surface, after backfilling, worked over with a harrow, leaving the ground in better condition than before the work started.

Rock Excavation.—Seven thousand cubic yards of ledge had to be removed in excavating the trench. The procedure was to drill the ledge with two drills mounted the proper distance apart on a movable frame. The frame was moved by a tractor on which was mounted an air compressor of sufficient capacity to run both drills at the same time. The drilling was



Making concrete pipe for the Portland Water District.

Laying a 48-inch pipe weighing seven tons.

done through any overburden of earth that might be over the ledge instead of the more common method of uncovering the ledge first. This procedure was very successful, the shovel removing the earth and broken ledge in one operation.

Venturi Meter.—A 48″ x 16″ cast-iron Venturi tube was installed in the line at its upper end near the source of supply. The recorder was installed in a meter house about 150 feet from the meter and connected to it with 1½″ copper tubing.

30-Inch-Pipe.—As a part of the contract and to complete a dual supply from Sebago Lake to the center of the city, 4,000 feet of 30″ Lock Joint pipe was laid in streets and between houses.

Because the size of this pipe made it impracticable to use the lead gasket type of joint, the rubber ring type of joint was used on the 30″ pipe. The manufacture and laying of this pipe was handled in the same way as the larger pipe.

Testing & Chlorinating.—When the 48″ line had finally been completed and ready for use, it was chlorinated and tested for leakage, the two operations being carried on simultaneously to save time. When the line had been well flushed, the entire seven miles was filled for the leakage test, and chlorine added as the line was being filled. Chlorine was introduced at a rate that resulted in the pipe being filled with water carrying 20 p.p.m. of chlorine. This was allowed to stand overnight and then well flushed out and the main finally filled with clean water ready for use.

While the chlorinated water was standing in the pipe, the entire seven miles of 48 inch pipe was tested for leakage. The requirement in the contract was that the leakage should not exceed 100 gals. per inch mile per 24 hours. This was but one-half of that often required, but our experience with Lock Joint pipe indicated that the results would be much less. The leakage turned out to be only 20 gals. per inch mile for 24 hours.

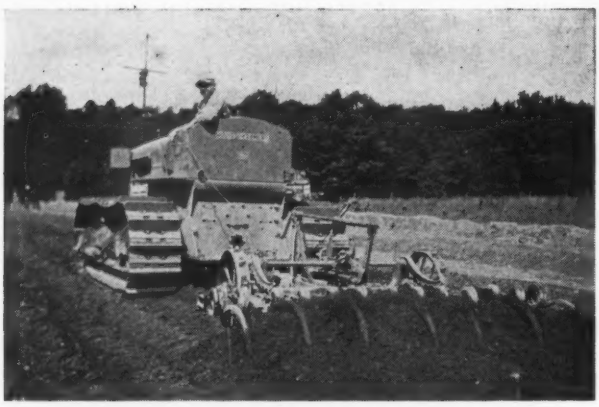
Cross-Connections.—The previous supply line and this newest supply line were cross-connected at three points in the seven miles of their length. In the event of trouble with one of the lines, it will be possible to shut off a part of one line and by-pass the water to the other, still leaving a large part of the system in operation. The cross-connecting pipes are 30″ in diameter with three gates at each connection.

The three gates, with the pipe between them, were enclosed in a concrete chamber with a concrete roof and an entrance manhole.

Quantities.—The amount of work performed was as follows:

38,000 ft. of 48″ pipe
7,200 cu. yds. of ledge excavation
4,000 ft. of 30″ pipe
3 cross-connections
Rebuilding chlorine house

The total cost of the work was $579,000. The entire work of making and laying the pipe was done by the Lock Joint Pipe Co. with John N. Vaughan acting as superintendent. The Venturi meter was furnished by the Builders Iron Foundry.



Thoroughly pulverizing the top soil with orchard cultivator.

Soil Cement

By THOMAS J. DuMONT
County Engineer, St. Joseph County, Indiana

SOIL cement road construction was first used in the State of Indiana last fall, when St. Joseph County employed it on several county roads with the aid of W.P.A. Three projects, totaling 6.78 miles, were set up for soil-cement construction. They were: (1) The Elm Road, length .73 miles and containing 8,563.6 sq. yd.; (2) The Douglas Road, length 2.55 miles and containing 29,917 sq. yd.; and (3) The Tulip, Tamarack, and Johnson roads, length 3.5 miles and containing 41,062.6 sq. yd. Of the three projects, only the Elm and Douglas projects were completed. Considerable grading was accomplished on the other, but only one section 1,280 ft. long was processed. With freezing weather, soil-cement construction was halted until spring but W.P.A. forces continued with the grading and drainage construction this past winter.

On the first and third projects, the gravel was hauled in from borrow pits located in the vicinity. The Douglas road had been gravelled previously with wash-run gravel, so it was not necessary to import additional material. Eight per cent cement by volume was used on the Elm and Douglas roads and 9% cement by volume was used on the other project. It would have been possible to harden the existing surfaces on both the first and the third projects by using a much higher cement content, but in view of the saving in cost of cement and a better finished product, it was decided to import gravel.

Prior to actual work on any of the roads, a sample cross section of the existing road bed and of the materials that were going to be added (in our case, bank-run gravel) was sent to the laboratory and subjected to durability tests by freezing and thawing, wetting and drying, to determine the cement content required to modify the road, waterproof and harden it. The moisture content in the sample mixture was checked for the point producing the greatest density. When the results of these tests were received, actual work was started on the road.

The equipment used in the construction of these projects included one 60 AC caterpillar type tractor; one 35 caterpillar tractor; one 60 AC pneumatic tired tractor; one small Farmall tractor; one 8-ft. Seaman tiller; one water pump; one 1,100-gal. pressure distributor; one Huber 10-ton, three-wheel roller; one Oliver orchard cultivator; one two-section sheeps-foot roller; one single section sheeps-foot roller; one four-bottom Oliver gang plow; one two-section spike tooth harrow; one homemade broom drag; one single bottom farm plow; one 10-ft. tandem drive AC auto patrol; one pneumatic tired roller; and one 8-ft. road grader.

The steps in the processing of each project were essentially the same and were divided into five operations: (1) preparation for processing; (2) dry mixing; (3) wet mixing; (4) compacting; and (5) finishing.

The four-bottom gang plow turning material toward the center.

The day before a section was to be processed, the material was carefully bladed to the desired grade and crown. It was found advisable to have the loose material graded about 1 inch higher than the finished grade, to allow for compaction. Wooden forms were placed along each side of the roadway, insuring a mix only within the boundaries of the forms and a constant width of the road with a smooth edge. With the auto patrol and a scarifier attachment, the entire section was carefully scarified to a depth of 5½ inches. The depth of the base constructed on each project was 6 inches, but the section was scarified only 5½ inches because experience has shown that the mixing equipment will usually cut an additional ½ inch during the dry and wet mixing operations. The four-bottom gang plow, powered by the 60-caterpillar tractor, the orchard cultivator powered by the 35-caterpillar tractor, and the Seaman tiller powered by the 60-pneumatic tired tractor, were then used to pulverize the soil thoroughly. The section was then bladed lightly and barricaded. When the weather was threatening, sisalkraft paper was placed on the pulverized section to protect it from rain. At the beginning of a new project, several moisture-density curves were run to check laboratory results and set up job control factors. (See page 78 *Soil-Cement Roads* published by the Portland Cement Association.) On some sections the moisture content was far below the specified optimum moisture content and water was added and mixed thoroughly with the soil. By doing this, considerable time was saved during the wet mixing operation on the following day. However, it was discovered that it was best to keep the

Construction Methods for County Roads

Methods and equipment used in constructing 6.78 miles of such roads, the first to be constructed in the State of Indiana.

moisture content at least two points below the specified optimum. Too much moisture during the dry mixing operation increased the hydrating of the cement and made a thorough mixture of soil and cement harder to obtain the following day.

Dry Mixing Procedure

At 6:00 A. M. the W.P.A. forces would begin spotting the cement bags and spreading. All of these projects were constructed for a width of 20 ft. and the bags were spotted in rows of five across the roadway. The two outside bags were each placed 2 ft. from the edges and the other bags placed 4 ft. apart. Thus, each bag would cover a distance of 4 ft. and the bags were dumped in a uniform windrow across the roadway. The longitudinal spacing varied with the cement content used. The windrows were spread uniformly longitudinally by hand labor using garden rakes. It was necessary to take out all ruts before spreading to avoid a concentration of cement. For a 1000-ft. section it took the W.P.A. forces between 2½ and 3 hours to spot and spread the cement. Immediately after the spreading was completed, the orchard cultivator and Seaman tiller were placed on the section to cut the cement in. They were run slowly for several rounds to avoid loss of cement due to dusting. After the cement was thoroughly cut in, the auto patrol or 8-ft. road grader, supplemented by hand labor, would pull the soil and cement just adjacent to the edges (wooden forms were used on all of these projects) towards the center. This was necessary because it was difficult for the equipment to mix within a foot of either edge. The four-bottom gang plow was then placed on the section and the material plowed from the center line towards each edge. This piece of equipment turned

Cutting the cement into the roadway with a rotary tiller and a cultivator.

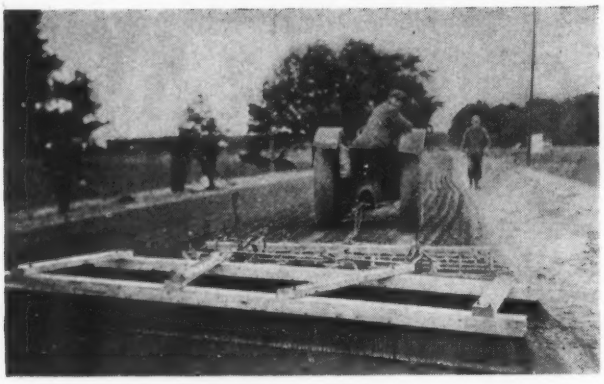
Pulling the edges from the wooden forms.

the soil-cement mixture completely over and set the pace for the other mixing equipment. After the mixture had been turned completely over by plowing toward the edges, the plow and other mixing equipment reversed their direction and plowed toward the center. The plow reversed its direction so as not to cause a displacement of the soil-cement mixture to the edges. After the soil and cement had been completely turned over twice and thoroughly mixed, a check on the moisture content, compared with the moisture content of the raw soil, showed the moisture loss due to evaporation and the incorporation of cement. Under normal weather conditions this factor will be found to remain fairly constant. All soil-cement tests are based on the dry weight of the soil.

Steps in Wet Mixing

The soil and cement having been uniformly incorporated, we were ready to add enough moisture to bring the mixture up to the specified optimum moisture content. The difference between the optimum moisture content specified and the moisture contained in the mixture at the completion of the dry mix, plus the estimated amount lost due to evaporation during the wet mixing operation, is the per cent of moisture to be added. Using the maximum density in lb. per cu. ft. specified for compaction, the actual gallons of water to be added were calculated. Charts may be constructed to reduce the work of making these computations in the field. (See page 77, *Soil-Cement Roads.*) Successive increments of water were applied with a pressure distributor moving at a uniform rate of speed.

After each application of water, the moisture was thoroughly distributed by the same equipment and in the same manner as outlined during the dry mixing. Towards the completion of the wet mix, a moisture-density check was made. (See page 78, *Soil-Cement*



Brooming to distribute the top surface before rolling.

Roads.) This procedure evaluates several variables occurring during mixing operations and is important to accomplish the best possible results. At the conclusion of the wet mixing, final moisture determinations were made on composite samples representing each 200 ft. of roadway.

Compacting and Finishing

After the mixing equipment had completed its work, sheepsfoot rollers were used to compact the mixture. These rollers exert a pressure of about 200 lb./sq. in. and compacted the mixture from the bottom to the top. As the rollers began to reach the top, the auto patrol was moved onto the section to blade it to the final grade and crown.

The sheepsfoot rollers were were kept at work until the feet came to within about an inch of the surface.

The auto patrol then moved back on the section to do the last shaping and mulch out this top one inch of material. It is very important that all the care and precaution that is possible be used in this step of shaping the road. At this stage of construction the material is hardening at a rapid rate and there is no other time that shaping of the grade can be accomplished. If evaporation losses were high, a light application of water of about .20 gallon per sq. yd. was applied. The surface was then scarified with the spike tooth harrow to remove compacting planes and surface marks caused by the rollers and patrol. The entire section was then broomed with a light broom drag to distribute the mulch evenly, and rolled with a 10-ton smooth steel roller to knit the top surface tightly together. Care was taken to lap half the width of the roller on each strip. The pneumatic-tired roller was then placed on the section for the final finishing operation and allowed to operate until all the mixture was incorporated or evaporated.

All of these projects contained from 20% to 50% material retained on a No. 4 screen and this final rolling helped to knit the stones tightly in the surface. The entire surface was then covered with about 5 lb. of straw per sq. yd. to prevent evaporation in the surface and allowed to remain for at least seven days. If evaporation losses are high, this straw cover can be wetted occasionally.

It is very important that the density specified for compacting be obtained. Each day checks were made on the completed work to determine the actual density obtained. (See pages 79-82, *Soil-Cement Roads.*)

Summary.—The soil on all of these projects was a sand and gravel containing from 20% to 50% material retained on a No. 4 screen. These soils are classified in the U.S.P.R. soil grouping as A-2 and A-3. All of these projects have a very hard, durable surface. There is a slight raveling in spots where the percentage of material retained on the No. 4 screen ran high or where the breakdown of a piece of equipment caused a bad finish. However, the projects in general are most satisfactory and are expected to give excellent service.

Management of Refuse Dumps

The following are a few of several suggestions for managing refuse dumps given before the New Jersey Health and Sanitary Association by Harry R. H. Nicholas, District Health Officer of the State Dept. of Health.

The material available for disposal can be roughly classified into three parts—the wet, the dry and the inflammable. By employing the best method of placing these materials on the dumps much can be done to reduce the customary complaints. All inflammable material should be so placed on the surface of the dump that, when it is burned, there is no danger of setting fire to the decomposing organic matter in the dump. A source of water should be available to control such fires if they occur. The wet garbage can then be spread on the surface of the dump in an area about 20 feet wide and 6 to 8 feet high, and each day's accumulation should then be covered with ashes or street sweepings so as to leave as little as possible exposed to the elements.

This concentration of the wet garbage in a small area, which is covered daily, is the basic procedure in good dump management.

Another valuable asset for good dump management is the use of a heavy bull-dozer. These machines, which consist of a caterpillar tread tractor with a large movable plow in front, not only keep the surface of the dump level, preventing mosquito-breeding pools from forming, but will also prevent many a broken spring on garbage trucks.

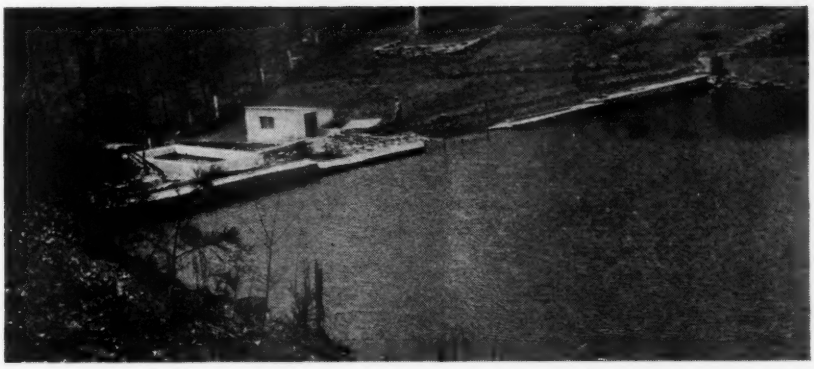
Another use of these bull-dozers which is often overlooked is its aid in the preventing of rat-breeding places. When I said heavy bull-dozer, I meant one of the largest size made, so that its weight is a factor in more densely packing the refuse. Also more refuse can be placed in a specific area than when such a machine is not used. These machines, if not owned by a municipality, can be rented periodically from private contractors.

National Congress on Surveying and Mapping

The first meeting of engineers, teachers and private agencies interested in surveying and mapping will be held in Washington, D. C., June 16 to 18, sponsored by the Committee on Surveying and Geodesy of the Society for the Promotion of Engineering Education, the Surveying and Mapping Division of the American Society of Civil Engineers, the American Society of Photogrammetry, and the Federal Board of Surveys and Maps. Several agencies of the Federal government will be represented, as well as practicing engineers and instrument makers. There will be exhibits of recent developments in equipment for both ground and aerial surveying.

The purpose of the meeting is to provide a national forum where all of those interested will be able to exchange views and information. Plans for a permanent organization will be considered.

J. F. Bearden



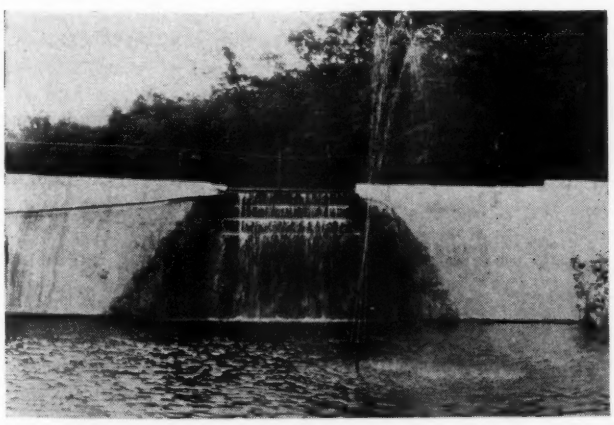
Chlorinator building and shrubbery plots are shown beyond dam.

Beautification of Water Works Grounds at Walhalla, S. C.

By J. F. BEARDEN
Supt. Water Works, Walhalla, S. C.

THERE is every reason why the site of a water works plant should be a clean and beautiful place rather than an unsightly one. There need be no defense of the investment that has been made at small cost in the beautification of the grounds surrounding the water works plant. If clothes make the man (and certainly good dress gives one a sense of self-respect and poise), then how much more is it true that clean, beautiful surroundings lend an improved tone to the water works grounds.

Last year our water commissioners adopted a plan for a beautification program, which would be a safety measure as well. Our watershed area consists of five hundred acres of virgin forest. Here were trees of almost every species. We have planted, during the past year, additional trees, mostly southern long leaf and hemlock, together with shrubbery around the lake proper. Our plantings also include lawns, roses, dahlia gardens, and varieties of beds and borders of many flowers. Also we have begun a garden of gladiolus. We are blessed with an abundance of native azelea and other forest flowers. Our first flowers begin giving a radiance of blooms in March and continue through December. We shall add continually to these plantings and we trust in the very near future we can see in them a well developed plan of beauty, as well as of safety.



View of spillway, Walhalla water system.

The director for this area of the Sumter National Forest, Mr. Weisse, has lent us every aid and suggestion.

The watershed is well protected by fencing of the entire area and is patrolled. No part of this area is inhabited and no cattle are permitted on it. No one is allowed on the area except by permit from the department, and when such a permit is granted someone from the department accompanies the permittee. The springs which furnish our supply rise in this watershed area.

We find that, with the exception of the dry periods, we have an abundant supply, but have realized that a new source of supply would have to be added. With this in mind, in 1935, we laid two miles of 8 inch c.i. pipe and installed an 850 g.p.m. pumping unit. This pumping unit is so arranged that water is pumped into our 35 million gallon storage basins, so that in both our beautification program and our safety program we are making steps toward future security.

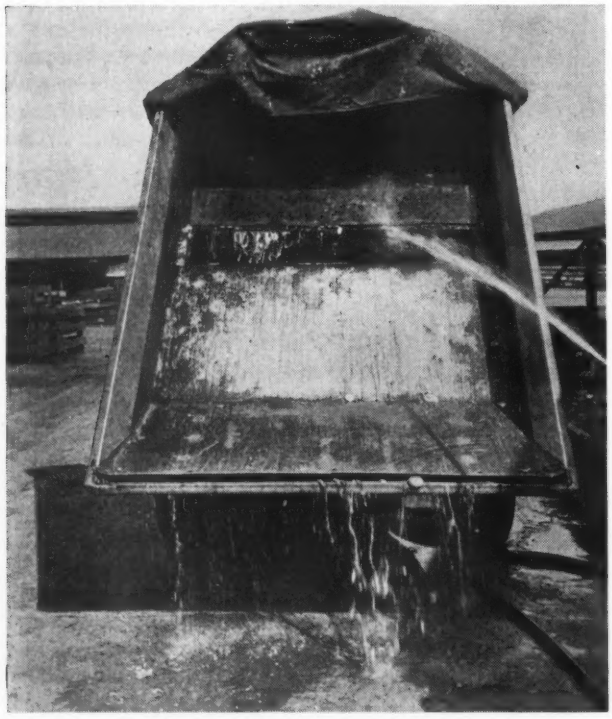
Kansas City Saves

By C. A. MAHON
Chief, Division of Garbage

Arthur C. Everham.

C. A. Mahon.

Truck, with end gate in place, draining from false bottom into drain basin, which is wide enough to accommodate four trucks.



Washing the emptied truck. Water entering the open trap door is seen flowing out of the spout of the false bottom.

THE April, 1940, election brought about a complete change in the Municipal Administration of Kansas City, Mo. A new Mayor and Council were elected, and these men searched country-wide for the best City Manager, trained to the work, that could be found. L. P. Cookingham, a former President of the International City Manager's Association, and a man with a fine record in civic achievements, was selected for City Manager. Mr. Cookingham appointed outstanding men, from the community, to fill the positions of Department Heads. The city was put on an efficient, business basis that has brought many savings to the taxpayers. A drastic revision of the operations of the Division of Garbage, which is under the Department of Public Works, is just one example of this fine work.

Kansas City, with a population slightly in excess of 400,000 persons, collects and disposes of about 55,000 tons of garbage each year. Collection is made from every home and commercial establishments in the city, the commercial garbage constituting about 22% of the total. Two collections are given the residential districts in the winter, and three in the summer, and daily collections are made from the commercial establishments. The city makes no trash collection so that all garbage is separated by the householder and commercial establishments and placed in special cans, provided by the citizen, at the rear of the house. The service is exceptionally good; with over 10,000,000 stops to be made each year, there were only 435 justified complaints last year. Disposal consists of feeding all garbage to hogs, and grinding the residue and emptying into the sewer.

For sixteen years, the work of collection and disposal has been done under contract by the same company. The equipment used in collection consists of 30 1½-ton dump trucks and 14 flat bottom trucks. The former collected all residential garbage and the latter the commercial garbage. The commercial garbage is handled by an "exchange can" system. The citizen's full can is removed and an empty can is left.

This plan was initiated in 1925 when this company was given a 10-year contract. In 1935 the contract was again placed with the same company for another 10-year period. The price paid for collection and disposal varied from $7.45 per ton to the present price of $5.35 per ton.

The contract, now in force, provides for cancellation of the contract on six months' notice, in the event the city builds an incinerator. The contract is under the direct supervision and control of the Department of Public Works.

Arthur C. Everham, an exceedingly competent and capable executive and engineer, was made Director of Public Works in May, 1940. Through his determined and tireless efforts, and with able assistance from William H. Smith, his assistant, a complete survey of the garbage situation was made, not only fully

$100,000 Per Year on Garbage Collection

Contract price was reduced $1.50 per ton, and weight reduced about 3½ per cent by draining off water through false bottoms in garbage trucks.

covering Kansas City, but correlating the facts from cities, countrywide. This was published in the form of a 52-page pamphlet, and has received wide recognition for its accuracy and completeness of the most recent developments in garbage collection. With complete data on hand and with a determination to build an incinerator unless a drastic reduction in contract price was forthcoming, a revision of the contract was secured, on January 8th, 1941. This covered, broadly, three main points: First, no reduction or curtailment of service; Second, a reduction in the price for collecting and disposal from $6.85 to $5.35 per ton; and Third, a method for draining all extraneous moisture from the garbage, before it is weighed. The savings of $100,000 per year were accomplished by these revisions.

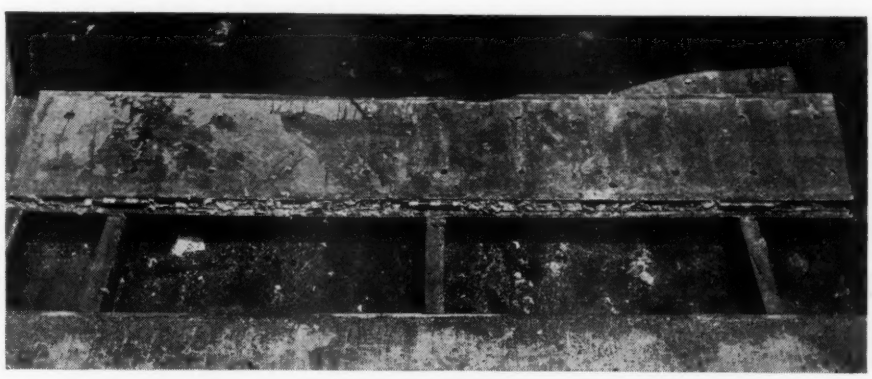
Although the greatest saving in dollars and cents was accomplished by the $1.50 per ton reduction in price, the draining of the water has saved the City many thousands of dollars, and the method is sufficiently unique to seem to be of considerable interest to others.

Close supervision and inspection revealed that the trucks serving residential areas were hauling many gallons of water in the garbage. Particularly after heavy rains, it was obvious that the weight of this water was a large percentage of the entire load of the garbage. Experiments were made, in several different ways, to separate the water from the garbage and to arrive at a weight of this water. After weighing and measuring of the water separated from a number of loads, the City began docking loads which came in with excessive amounts of water. These dockages were purely estimates, but totaled from 30 to 45 tons per month.

In order to determine more accurately the amount of water contained in these loads, the Contractor installed "false bottoms" in four of the trucks. These "false bottoms" were a metal sheet welded into the dump bodies of the trucks, about three inches above the bottoms of the bodies, and completely covered the bottom, and were also inserted above the sloping rear ends of the bodies, providing a "spout," for the ready draining of the water, which collected in the main section. The false bottoms were drilled with 5/16" holes, for the water to seep into the vault, and were also provided with a trap door, which could be opened to permit flushing and cleaning of the vault. Due to the shaking of the garbage, when the trucks are in motion, practically all of the free water in the load is drained down into this lower vault. The rear ends of the dump bodies were drilled with three holes, and end-gate boards were made, with three rods which could be slipped into these holes, and securely holding the 12" board in place as an end-gate. With this extra end-gate in place temporarily, while the load is being "drained" of the water in the lower vault, there is no danger of the load slipping off. The water rushes out instantly, when the truck is raised to about 4/5 of the way into full dumping position. The end-gate is then slipped off, and the garbage is weighed, with the water out and on its way down the sewer.

For several months, during the experimental period, the loads of garbage were weighed before and after "draining." The four trucks, so provided with false bottoms, were selected according to type of territory they covered. Two were from poorer neighborhoods, where cans were bad and lids very scarce, the other two trucks were from the better neighborhoods. The water content was always heavier in the poorer neighborhoods, but it varied according to the weather. For three or four days following a heavy rain, these trucks would bring in from 8 to 17 per cent water. In dryer periods, this would drop to 3 or 4 per cent water. For the entire test period of 4½ months, the average on the wet routes was 6½% and on the dry routes 2½%, or an average for both of approximately 4½%.

All of the residence trucks are now provided with the false bottoms, and the water is no longer weighed, so the amount of water drained from the trucks and not paid for, can only be estimated. From the experiments made, and knowing the number of trucks which approximate the wet routes and the number that approximate the dry routes, it is known that about 3½% of all garbage by weight is drained off. This is not paid for by the City. Kansas City is therefore saving approximately $10,000 each year from the draining of water from the garbage, and $90,000 from the reduction in price of collection and disposal.



Close-up of trap door, showing perforations and braces under false bottom.

Toxic Contaminants of Drinking Water

Amounts of arsenic, boron, calcium, chromates, copper, fluorides, lead, sodium hexametaphosphate, selenium and zinc that are permissible.

By LAWRENCE T. FAIRHALL

PERMISSIBLE amounts of various toxic contaminants in drinking water, as shown by research and experience, were outlined by Dr. Fairhall, who is Principal Industrial Toxicologist of the National Institute of Health, in a talk before the New England Health Institute. This article is an abstract of that talk.

The problem of the contamination of water supplies is related to economic waste, wild life and fish conservation, corrosion of shipping and bridges and drinking water supplies. Many chemical wastes contain materials injurious to health, although enormously diluted, and strict surveillance must be maintained to see that they do not rise to dangerous levels. Of the substances that, at various times or in various localities, have been reported as contaminants of drinking water, the following are prominent: Acids, arsenic, boron, chlorides, certain chromates, various disinfectants, copper, fluorides, saline wastes, iron, lead, manganese, selenium, sodium hexametaphosphate, and zinc.

On the other hand, a water requires certain elements necessary for faunal or floral life, for these play a significant role in stream life and are of some importance in insuring a clean water. According to Ellis (Report, Bureau of Fisheries, Aug. 1, 1935), these standards include: A dissolved oxygen content of not less than 5 p.p.m.; a pH range between 6.5 and 8.5; certain ionizable salts; not more than 1.5 p.p.m. of ammonia; and suspensoids of certain characteristics.

The question of undesirable contaminants is largely one of degree, and permissible standards have been determined largely by practical experience. To apply fixed and definite standards is difficult because of greatly varying local conditions.

Arsenic.—Lead arsenate spray material is much used in orchards for coddling moth control and in grass areas against the Japanese beetle. The Wenatchee, Wash., area is probably more heavily exposed to lead arsenate than any other in the United States, as much as 7,000,000 lbs. of lead arsenate, or 1/6 of the total used annually in the United States, being applied. Neither the lead nor the arsenic content of the drinking water is seriously affected. Tests show a lead content of only 5 to 20 parts per billion (0.005 to 0.020 p.p.m.), and an arsenic content of 5 to 6 parts per billion. Recent analyses of tap water at the National Institute of Health, just outside of Washington, D. C., showed a lead content of 4 to 7 p.p.b. In sections where pyrites exist, arsenic contents of 0.4 to 10 p.p.m., a dangerous concentration, have been found. The permissible amount of arsenic seems to be largely a matter of opinion, and some authorities claim that a content of as much as 0.15 p.p.m. can be tolerated without injurious effect.

Boron.—The distribution of boron appears to be restricted. Goudy investigated the Los Angeles supply, in which the boron content is 0.5 to 1.5 p.p.m. and reported this chemical not harmful and permissible up to 30 p.p.m.

Calcium.—The content of calcium is largely an economic problem. Even 1800 p.p.m. has no apparent ill effects; the content is therefore a matter of utilitarian rather than health interest.

Chromates.—One of the means used for preventing corrosion has been the formation of a film of soluble chromates. The salts of trivalent chromium have been shown to be harmless, those of hexavalent chromium have long been known as irritants, causing dermatites and ulcers. Apparently no information is available in regard to the effects of ingestion of such small amounts as might conceivably be added to a water supply.

Copper.—The physiological effect of copper has been a controversial subject for many years. Susceptibility varies among individuals, and it is probable that the human organism gradually adapts itself to the quantity of copper taken in. The amount of copper in drinking water is very low, except where the water is overdosed with copper sulfate or where a very acid water is carried in brass or copper piping, and copper therefore does not have any public health significance.

Fluorides.—Much has been published regarding fluorides and their effect on teeth of children. Acute toxic effects result when fluorine reaches 180 p.p.m.; retention in the system occurs when fluorine is present to the extent of 2 to 3 p.p.m.; dental alterations will take place at 1.2 p.p.m.; no effects appear to occur when drinking water contains up to 0.6 p.p.m.

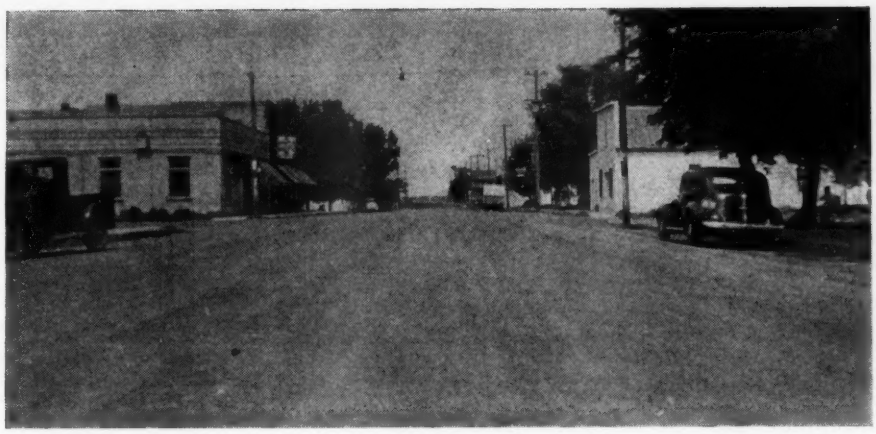
Lead.—There is little, if any, danger from the use of lead pipe, except possibly in New England. Weston established a permissible lead content for drinking water of 0.1 p.p.m., but in Holland and Germany the maximum is 0.3 p.p.m. A content of 2 p.p.m. is definitely dangerous. White lead joint compound, if used in excess, may increase the lead content of water.

Manganese and Iron.—Neither of these materials appears to have any harmful effect upon persons using the water. Both of them are, however, objectionable from the utilitarian viewpoint.

Sodium Hexametaphosphate. — This material possesses remarkable properties in regard to water control and softening. A question has been raised regarding its physiological action, concerning which little seems to be known. If, as has been stated by Behrens and Seelkopf (Archives and Experimental Pathology and Pharmacy, *169,* 238, 1933), the sodium hexametaphosphate is broken down in the stomach to sodium phosphate, there is no need for agitation.

Selenium.—Little is known of selenium poisoning of man, and the amounts of this chemical occurring naturally in water, even in seleniferous regions, appear to be quite low. In the Colorado River basin, the selenium content ranged from 0 to 400 parts per billion; in the North Sea it was 3 or 4 parts per billion; and elsewhere it has been found in quantities up to 0.4 to 0.5 p.p.m.

Zinc is indicated by an objectionable taste before any harmful concentration is reached. No data on actual contents that may be harmful are known.



Every street is stabilized in the Village of Avon.

Stearns County Experiments with Calcium Chloride Stabilization

Five miles of gravel roads, stabilized in 1940, are no longer dusty and full of chuck holes. Local materials used, ordinary county equipment and simple methods of treatment.

By JOHN S. SCHMIT
County Engineer, Stearns Co., Minn.

UNDOUBTEDLY, the most frequent and severe criticism directed against a county highway department is caused by the ever-present corrugations, chuck holes, loose aggregate and choking dust so prevalent in untreated gravel highways. This combination of irksome conditions has caused motorists to voice their acid opinions of the road in particular and of highway engineers in general.

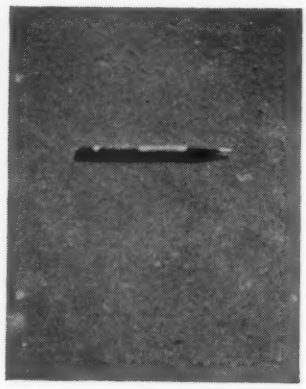
Stearns County, situated in the central part of Minnesota, is typical of many other sections of Minnesota and its neighboring states. Gravel is found in numerous localities and this material constitutes the usual road wearing surface. Our county highway system consists of 760 miles, and with the state highways, serves 67,000 people. The main industry in the rural area is dairying and catering to the tourist traffic, which is attracted by excellent vacation facilities. A large stone quarrying industry, centered at St. Cloud, imposes heavy loads on our roads. The resulting traffic, particularly in the summer season, has demanded continuous road maintenance, due to the sandy, unstable nature of our soils. The density of traffic, light soils and occasional long periods of dry weather have combined to create a problem of summer maintenance the cost of which has steadily increased without any apparent improvement.

In 1939 clay was added to loose aggregate on several miles of a graveled road carrying considerable traffic, and these components were mixed and shaped, and a short street was given a light application of calcium chloride. A marked improvement was noted, but the results did not prove entirely satisfactory. Raveling and washboard corrugations began to appear shortly after the consolidation process, due primarily

Disc plowing.

Mixing operation north of St. Cloud.

John S. Schmit.



Typical stabilized surface.

to the poor quality of the binder soil and improper gradation of the aggregate.

In the spring of 1940, a W. P. A. project was set up for the stabilization of 5 miles of county roads leading into Sauk Centre from three different directions. Construction procedure was as follows: All loose aggregate over 1-inch was removed from the surface by hand raking. The remainder was windrowed, and screened; pit-run gravel was added in sufficient quantity to provide 1,000 cubic yards per mile. To this was added 400 cubic yards per mile of clay binder soil containing a small percentage of sand. Using a power patrol, these materials were thoroughly mixed and blended and with the aid of rainfall, which provided sufficient moisture, the windrow was laid out over the roadway surface and shaped to an A type crown with ¾-inch to the foot slope. Compaction was obtained by traffic, with occasional light bladings, particularly after rains, to retain a smooth, properly shaped surface while compaction was in progress. About a month later, calcium chloride was spread at the rate of 6 tons per mile. Twice during the remainder of the season, at intervals of approximately 7 weeks, two applications of calcium were added, making a total of 10 tons per mile for the season. The total cost of the completed surface, including the two subsequent applications of chemical, was $2,892, or slightly less than $600 per mile. During the summer, blading was required previous to the two maintenance applications and also after two heavy rains. The total cost of this was $13.50 per mile compared with $90 to $100 per mile in previous years.

Our stabilization program during 1940 consisted of twenty separate projects, varying from ½ to 13 miles in length and totaling 68 miles. Of this total, 20 miles were treated with calcium chloride, comprising 9 projects located throughout the country. On these numerous projects, considerable variation in the grades of binder soil and aggregates were encountered, requiring a continual change in material percentages. Clays, ranging from a pure, high P. I., grade to soils with a high percentage of sand were used. Also the aggregates varied considerably. In the early stage of our program, the aggregates contained a large amount of coarse material in sizes up to 1¼ inches. On subsequent jobs, this maximum size was gradually reduced, until at the present time, materials are being crushed to ⅝ inch. Experience has shown that coarse aggregate is objectionable. It is difficult to secure an even mixture and also to obtain a smooth surface, due to the pulling of the larger stones when blading, causing grooves.

A binder soil, consisting of clay and containing a small percentage of sand, produced the best working conditions and the best finished surface. This blended more readily with the aggregate, reducing our mixing and shaping costs. However, on one project we used what is commonly called "brick clay" with results that were very gratifying. Rains hindered the mixing process to a great extent and at this stage of the construction it appeared quite evident that the clay content was too high. For a considerable time after the final shaping a light rain would cause a slippery condition which was finally eliminated by several light spreadings of sand applied with a calcium chloride spreader. These blotter coats were immediately absorbed by the excess clay and resulted in a smooth, hard surface previous to the calcium treatment.

Our initial coat of calcium was spread at the rate of 1 pound per sq. yd.,—an average of 6 tons per mile —on all projects. Subsequent treatments consisted of 2 tons per mile and were considered necessary whenever a slight raising of dust was noted. On projects completed in the months of June and early July, two maintenance applications were found sufficient for the remainder of the season.

Blade maintenance will usually be required previous to the light applications of chloride and after prolonged or unusually heavy rains. A light blading is sufficient to secure a smooth surface, whereas heavy cutting is detrimental to the roadway. Some of our projects required a maximum of 6 bladings covering a period of approximately 3 to 4 months, while one treated road, carrying considerable traffic, did not receive a single blading from June 24th, when the project was completed, to the present date (March 12).

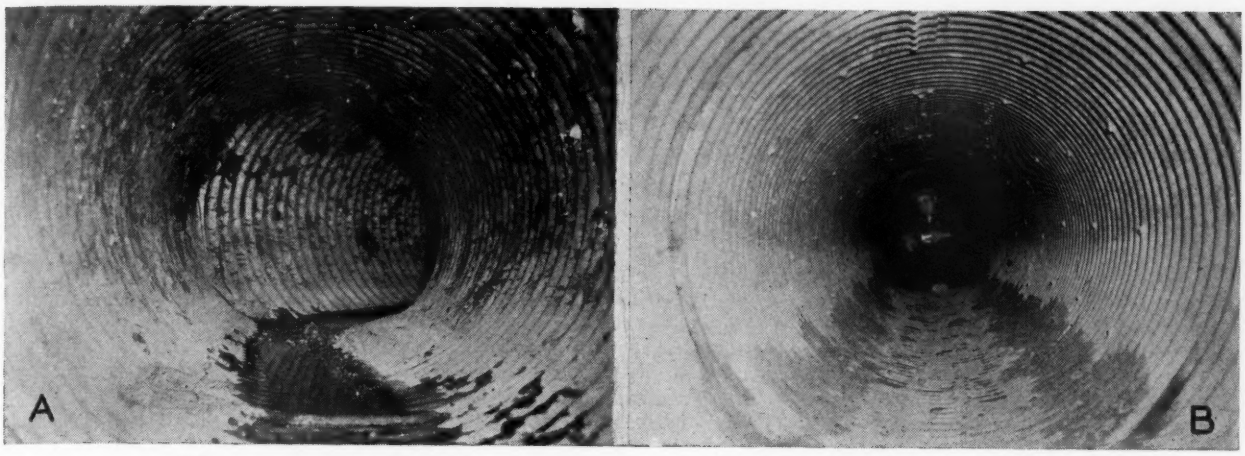
Another maintenance item which will be found necessary is patching. The same materials are used as were incorporated in the stabilized course. This is either taken from stock piles or, if suitable, from the right-of-way. The patching mixture should include a slightly higher percentage of binder soil. Calcium chloride is added to the mixed materials or spread on the surface after completing the patch. Care should be taken not to use an excessive amount of the chemical.

As we consider our 1940 treated stabilization work still in the experimental stage, no definite program for the future has been inaugurated. Although we have obtained a smooth, dust-free surface on all our projects, we believe it will require several years of observation to determine the relative advantages of this type of surfacing to the user and to secure reliable data pertaining to costs. The service to traffic and the comfort to the property owners along these dustless highways have already been demonstrated.

Another important factor which should enter into the estimated value of stabilization is the consideration of this type of surfacing as a step in the stage con-

(Continued on page 53)

Typical gravel surface previous to stabilization.



Whitman storm drain outlet.

West Whitman St. 36" sewer.

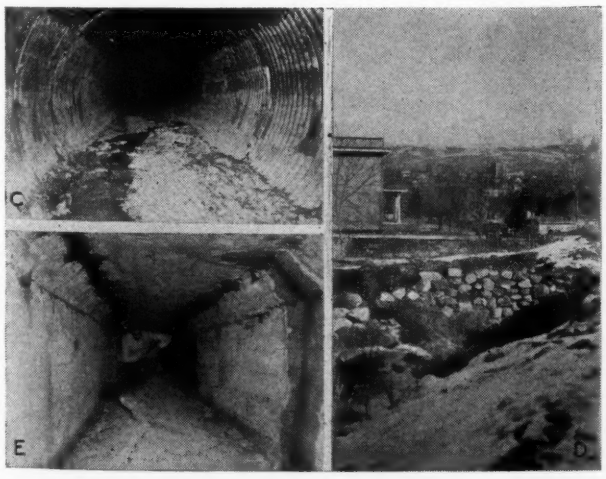
Steep Storm Sewers in Pocatello

By R. C. LOWRIE
City Engineer, Pocatello, Idaho

Storm sewers laid 27 years ago using corrugated iron pipe 36" and 42" diameter, with unprotected inverts and steep grades, still in good condition.

TWENTY-SEVEN years ago Pocatello, Idaho, built two storm sewers, in Whitman St. and Clark St. respectively, to catch run-off water from canyons and carry it under street surfaces. Both were laid on rather steep slopes, reaching a maximum of 8%. Both received the run-off into a mouth unprotected by a screen of any kind and as a result considerable amounts of gravel and large stones were washed into and through them.

The Whitman Street sewer is 36" in diameter, 1150 feet long, with a maximum grade of 7.5% and a minimum of 0.33%. The Clark Street sewer is 42" diameter, 1120 feet long, with slope varying from 8% to 0.33%. Both were made of 12-gauge Armco corrugated iron, with no protection of the inverts against erosion by the stone and gravel that was washed over them at considerable velocity, except galvanizing.



C—Clark St. near outlet, some wear in invert. D—Unprotected entrance to Clark St. 42" sewer. E—West Fremont St. concrete box drain.

In spite of this, the Whitman Street sewer shows no appreciable wear after 27 years. The Clark Street sewer shows some wear on the corrugations, and no doubt it should be paved with a protective coating (such as it is now common practice to furnish on such pipe), which would give it many years of further service.

The Whitman Street sewer was found, on recent inspection, to be deflected downwards at the top about one foot at a point where a street crosses it. This was no doubt caused by the passage over it of heavy loads during the installation period and before the back-fill had settled thoroughly around it.

Another storm sewer was built in Fremont Street in 1923. This sewer is a concrete box 3 ft. by 3½ ft., 1300 ft. long. The maximum grade is 7.67% and the minimum is 0.33%. The entrance to this storm sewer was protected by a grill to exclude large stone and debris. The entrance is a bell-mouth about 25 ft. wide at the opening; the grill is formed of steel bars set at an angle of 45° with the vertical. Near the outlet, the flat bottom of the sewer has bulged up considerably and is badly broken, due possibly to frost action. (More probably due to settling and moving inward of the side walls because of insufficient support, the photograph suggests to us. Editor.)

Sewage Treatment in Ohio

"The period from 1934 to 1940 could be described as the most important era of sewage treatment in Ohio. It is not probable that at any 6-year interval in the future will an equal number of plants or plants serving as great a population be built. . . . If it is possible to summarize all of the plants, the general trend indicated would be toward the increased use of mechanical equipment in all processes and structures of the plants."—*W. H. Knox, assistant engineer, Ohio Dept. of Health.*

Maintaining the Capacity of Water Mains

Not least important among the many technical advances made during the past few years is that in protective linings for pipe. Water works now can obtain mains so protected that they can be sure of the full efficiency during the demonstrated and practically indestructible life of cast iron pipe. However, many miles of cast iron mains were laid before these linings were available or their importance realized; and superintendents in some areas who handle soft water supplies find that the capacities of their mains have been reduced due to aggressive water.—What can they do?

It is the purpose of this article to tell what can be done to restore and maintain the capacities of these old and otherwise satisfactory pipe lines.

A SURPRISING number of waterworks officials fail to realize the importance of maintaining the full carrying capacity of their mains. Almost every water works engineer or superintendent appreciates the necessity for repairing breaks and leaks, maintaining valves and hydrants and carrying on these routine repair and upkeep jobs; but any gradual reduction of pipe line carrying capacity often goes unnoticed, or is neglected because of the cost or trouble involved in remedying it.

Cleaning mains is a cure; it may be a temporary one, but even if it has to be repeated every few years it is usually still an economy, in fact a necessity unless the main is to be replaced by a new one. It is better by proper water treatment and other measures to prevent the occasional causes that may reduce the pipe line capacity, and so maintain the pipe interior in its original condition for an indefinite number of years to come.

Pitometer in use measuring flow in water main.

14" cast iron pipe in continuous service in Kenosha, Wis., from 1895 to 1938, when it was taken up and relaid. Original coating visible under a very thin lime deposit.

However, there have been instances where mains have been cleaned and the entire cost of cleaning was found to be repaid by the saving in pumping costs over a period of six months. In other cases, the restoration of the original carrying capacity of the line by cleaning has made possible a postponement of the construction of a new line for a number of years, the consequent savings being much greater than the original cost of cleaning.

Detecting Loss of Capacity

Insufficient capacity of a pipe line reveals itself most conspicuously by insufficient flow for fire fighting and by low pressure at the outlaying parts of the distribution system, especially by considerable difference between pressures at hours of minimum and of maximum consumption. This may be due, not to decrease in capacity but to increased demand upon it due to greatly increased consumption. Generally decrease in carrying capacity takes place so slowly that it is difficult to detect it except by actual measurements taken at intervals of several months. Unless there is certainty that no decrease is taking place, it is most desirable that actual measurements be made of loss of head and of flow through several stretches of pipe selected as being most likely to suffer such decrease and as offering conditions favorable to accuracy of measurement. Such measurements should be made at least once a year, and compared with previous ones; but considerable can be learned from the first one made.

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by comparing the measured flow with that calculated as the theoretical flow of new pipe.

The carrying capacity of a pipe line is usually computed by the Williams and Hazen formula, which is $V = CR^{0.63} S^{0.54}$ 0.001 $-$ $^{0.04}$ in which V = mean velocity in ft. per sec.; C is a coefficient; R = hydraulic mean radius, and S = quotient of loss of head divided by length of pipe.

The capacity of a pipe line is best indicated by its value of the coefficient "C," which is determined by the loss of head for a measured flow of water through a given length of pipe. Numerous tests and many years of experience have been utilized to build up charts or tables showing the relation between age and the coefficient "C" and consequent carrying capacity of the line. New tar-coated cast-iron mains less than 16 inches in diameter has a value of "C" of about 125; and larger pipe of the same kind a "C" of about 135; the exact value being affected by the number of bends and other specials. Since this article refers primarily to distribution system pipe, a basic value for "C" of 125 is assumed.

According to the Williams and Hazen charts, with a value of "C" for new pipe of 125, the coefficient at the end of 10 years of service under average conditions was estimated to be about 110; at the end of 20 years about 95; and after 30 years of service about 87. These data were for tar-dipped cast iron pipe. For pipe having smoother or rougher surfaces, the values of "C" will be greater or smaller.

Remedies for Capacity Loss

There are three main divisions of the problem presented by the condition referred to. The first relates to the protection of new pipe to prevent loss of capacity; the second, to improving the condition of old pipe already in use to restore its capacity and prevent future loss; the third, to removing from the water conditions that cause loss of capacity.

Fortunately, special varieties of pipe linings have been developed to resist those characteristics of the water that cause much of the trouble. These include cement linings and bituminous enamels. In addition, pipe materials have been developed that are in themselves resistant to many or all of these deteriorating influences.

In the case of new pipe, these linings are generally applied by the producer. For applying them to large lines already in service, the lines can be emptied and bituminous or cement linings applied after cleaning. Smaller pipe, which men cannot enter, can be cleaned and lined with cement in place by means of special equipment.

In many places, especially where the water is already being treated, corrective measures may be applied to the water that will reduce or eliminate deposits and corrosion, or produce a thin protective coating on the pipe. Special chemicals are also available that can be used without the necessity of constructing a costly treatment plant, which will effectively control many of the characteristics of water that cause deposits, tuberculation, growths, etc.

Cleaning Mains

Flushing.—Deposits in mains composed of suspended matters, both organic and inorganic, can generally be stirred up into suspension by increasing velocity of flow and, when so suspended, be removed by discharging the water through a fire hydrant or blow-off. At least one city has produced the desired stirring effect by blowing compressed air into the main.

It is customary in flushing large mains to open sev-

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 69-71

eral hydrants at a time, starting near the reservoir or pumping plant and working toward and into the distribution system. The most satisfactory method seems to be to start with three hydrants open at the same time; then to open a fourth, closing the first at the same time. As the fifth hydrant is opened, the second one from the starting point is closed. The same practice may be employed on principal distribution pipe. On small mains in streets where the deposits are light, it may be sufficient to open the end hydrant, or this and a special blowoff, where one is provided. If there is considerable deposit or it resists stirring, it is customary to open all the hydrants on a line, one after the other, or in successive groups of three or four as described for large mains.

Flushing is not generally adequate for removing deposits from solution, such as calcium carbonate, tubercles and other hard matters attached to pipe walls, but some more forcible method must be employed. The usual one involves the following steps: A run of pipe several hundred feet long is selected and an opening cut into it at each end, into one of which a cleaning machine is inserted. This may be either of two types, one of which is drawn through the pipe by means of a cable and the other one is pushed through by the water pressure in the pipe. Each has an arrangement of cutting and scraping blades that remove incrustration, tuberculation and deposits. A sufficient amount of water is allowed to pass the cleaner to carry away the material loosened and remove it to be discharged at the other opening. The cable-drawn cleaner is commonly used on 4-inch and 6-inch pipe, while the water-propelled machine is used on the intermediate and larger diameters.

After the machine has been inserted in the pipe, the cut through which it entered is permanently repaired and water allowed to enter the main behind the machine and push it forward. At the other end of the section to be cleaned, a riser pipe is placed to permit discharge of the removed material and the removal of the cleaner. After the machine has passed through the main (which requires only a few minutes, since a rate of travel of about 50 feet per minute is maintained) the water is shut off, the riser pipe removed and the opening in the main is closed and the main replaced in service. The total time that the water is shut off from any section is normally 5 to 7 hours. If the section cleaned extends from one valve to another, both of these are closed and no other part of the system is put temporarily out of service during cleaning. The same procedure is repeated successively throughout the system. Where it is anticipated that a main will need to be cleaned again in a few years, the openings made may be closed by a saddle plate bolted on or other device such as couplings that can be removed easily.

Since special devices and skill are required for such cleaning, it is customarily done by firms which specialize in such work. One of these guarantees that mains after cleaning will have a capacity at least 95% of the original. This firm reports that on small pipe, values of "C" of 105 to 110 are generally obtained; and on larger pipes values of 115 to 140.

If a pipe which has been cleaned is again subjected to the same conditions (such as character of water) that caused the trouble originally, the cleaning will need to be repeated in the near or distant future. The frequency of cleaning needed therefore will differ in different cities. In a few sections mains may require cleaning every year, while under other conditions cleaning at 5 or 10-year intervals may be sufficient to keep the distribution system in condition. When it be-

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The National Method restores the carrying capacity of pipe to at least 95 per cent of that of new main. That is our minimum guarantee.

This offers you five possible savings: GREATER DELIVERY, LOWER PUMPING COSTS, REDUCED INSURANCE RATES, ELIMINATION OF NECESSITY FOR PURCHASE OF NEW MAINS, and CLEAN WATER. Apply these savings and advantages to the cost of main cleaning, and you have economies that enable the cleaning to pay its own way in a short time of improved operations.

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More than thirty-five years of satisfactory service in pipe cleaning has produced an impressive record that is available to you on request, without obligation. The National Method is a means of cleaning clogged water mains by removing tubercles, incrustations, and deposits from the inner pipe walls.

Briefly, this involves cutting the pipe in two places, for entry and exit of the cleaning machine, placing a riser pipe at the exit through which first the muddy water and then the machine emerge, propelling it by water pressure or by cables through the pipe; finally, shutting off the water, removing the riser pipe, and reconnecting the main.

The total time required for shut-off of water in any district is five to seven hours. In an emergency, the pipe can be temporarily made up and the service resumed. The work can be done at night if desired.

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comes a question of either cleaning to maintain capacity and pressure, or installing a new line, even frequent cleaning is usually cheaper. Much depends, however, on local conditions, including the cost of pumping, the sufficiency of supply, the need for additional lines, and other factors. In some cases the increased cost of pumping due to partial closing of mains will exceed the cost of cleaning, both figured on an annual basis; and knowing the cost of cleaning, it is possible to calculate at what point in the continuously rising cost of pumping it will be economical to clean the mains. It may be desirable, before this point is reached or in a gravity system, to determine the time for cleaning by the permissible decrease in discharge capacity of the mains or in pressure.

Protecting Pipe Lines

Deposits of suspended matters are not caused by condition of pipe surface, and prevention of them is largely a matter of treating the water. But tuberculation and deposits involving chemical reaction with the iron can be prevented by proper coating of the interior of the pipe. This protection is generally best applied before the pipe is laid; but it can be applied to a pipe line which has been cleaned as already described, and thus retain the improved conditions and eliminate necessity for repeated cleanings.

The linings commonly applied for this purpose not only eliminate possibility of such future difficulties, but also provide and maintain higher flow capacities in the pipe. The former is accomplished by preventing the transported water from coming into contact with the pipe interior by the use of a suitable protective lining. These linings are subject only to exposure to water; strength to resist water pressure is not required as it is provided by the pipe walls. Desirable characteristics include resistance to penetration by the water, a smooth and even surface that will offer the least possible resistance to the flow of water and, to insure long life under all possible conditions, a substantial thickness and firm adhesion to the pipe. The materials used for this purpose are practically confined to portland cement and bitumens.

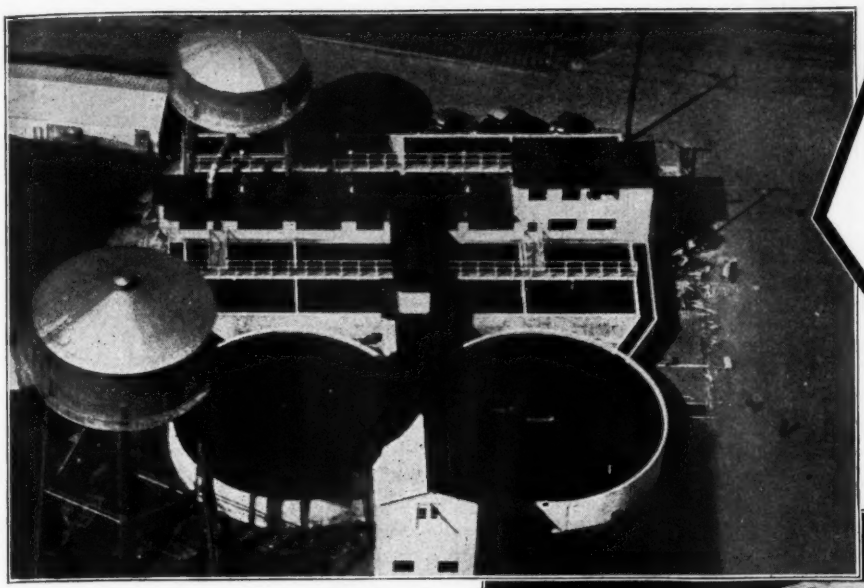
Cement Linings

General.—Linings of cement mortar have been used for a great many years with the primary purpose of protecting the interior of the pipe from corrosion and tuberculation. Cement-lined pipe laid nearly 100 years ago gave good service, some of them for 50 years or more, but the metal pipe used was too light for resisting modern pressures, which has been the chief cause for discontinuing these old pipe. The long-time results indicate that cement linings give adequate protection, and at the same time improve the flow characteristics of the pipe very markedly.

In view of these results, modern methods have been developed for lining water pipe with cement. Cement lining was at first made by water works employees by inserting the mortar in the pipe and spreading it against the wall by pulling a metal cone through it. Probably all lining now is done by manufacturers who apply cement lining by spinning the pipe into which the cement mortar mixture has been inserted; the centrifugal force resulting from the spinning spreads the coating very smoothly and evenly and makes it very dense and compact. The lining is generally made about 0.3 inch thick in 10 inch pipe and larger, and as thin as .06 inch in 1-inch pipe.

While adhesion of the cement lining to the pipe is usually very good, experience has shown that even a lining that is relatively loose when first applied may be satisfactory, and that hair cracks in the lining do

Aerial View of Eastern Accelator Installation Used for Clarifying River Water



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Infilco representatives are expert engineers *completely* familiar with *all phases* of water treating problems. Let one of these practical, down-to-earth, experienced men help you plan the best way to treat your water. A request to our offices will bring him, without obligation.

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"Centriline" pipe lining machine.

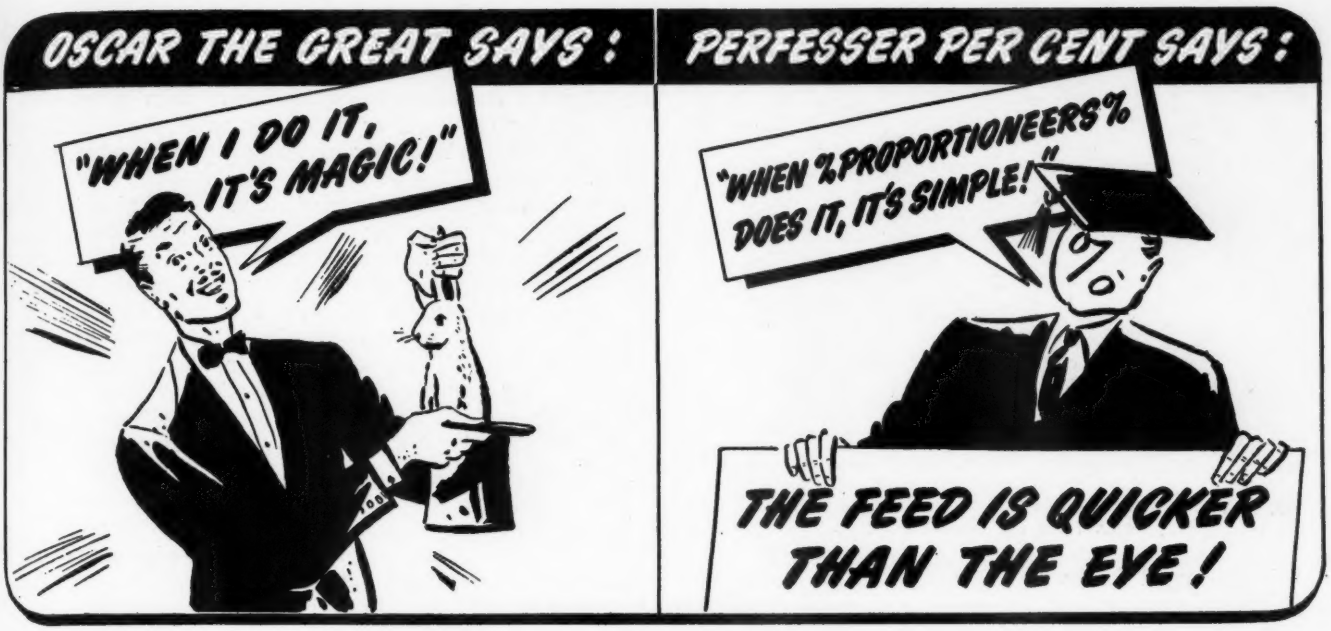
no damage; for when the lining becomes water soaked, it expands sufficiently to close small cracks and to fit the interior of the pipe tightly. Some manufacturers recommend use of lead-lined fittings for screw joints in small cement-lined pipe.

Corpus Christi, Texas, which about two years ago laid 16 miles of 30″ cast iron pipe lined with cement ½″ thick, found that cutting the pipe with cold chisel and hammer seldom chipped off the lining back as much as ¾″ from the cut. (Incidentally, the pipe joints were made with cement.)

Lining Large Pipe in Place.—The first step, of course, if the main has been in service, consists of cleaning the interior of the old pipe. (The methods employed for doing this have already been described.) The cement lining can then be applied by hand, by cement gun, or by a centrifugal machine. The first has not been used in recent years. Gunning was the method first adopted for large jobs. In this, the mortar is shot under pressure against the pipe wall, giving a dense concrete that can be built up to any desired thickness.

The latest method of applying cement lining is the centrifugal, the process being applicable to pipe of 36 inches diameter and larger. The procedure is as follows: The cement mortar is mixed on the ground level and delivered to the lining machine, which operates within the pipe underground. A relatively dry mortar, mixed about 1:1, is used. As the machine moves slowly through the pipe the mortar is thrown against the pipe walls by high-speed vanes; a series of curved paddles or trowels then smooth and finish the lining, producing a dense hard surface. The speed of the lining machine can be regulated to apply a lining of any desired thickness; normally this varies from 3/16″ to 2″. As this lining covers all rivets, laps, etc., it gives a continuous smooth surface and a carrying capacity that may be greater than that of a new pipe. A 48-inch steel pipe, which had been in service in Newark, N. J., for 40 years, was recently cleaned and lined. The "C" before cleaning was 70; after cleaning it was 110, which was the same as it was when originally constructed. After the cement lining had been installed, "C" was 124.

Lining Small Mains in Place.—A machine has been developed for cement lining in place small mains up to about 12 ins. in diameter. An auxiliary main (may be a 2″ galvanized pipe) to provide temporary service to consumers during lining is placed on the surface and all service pipes are removed from the main to be lined and connected to the auxiliary main; the holes in the main where the services were connected



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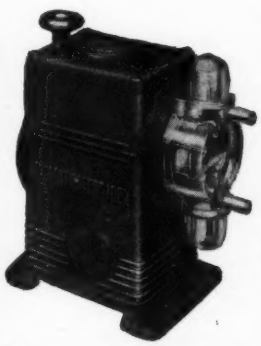

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1 "See-Thru" transparent plastic construction on chemical feeder reagent ends.

This improvement, by use of transparent molded plastics, has revolutionized Chemical Feeders. Now you can see what goes on inside.

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We released the aqua method of ammoniation for general use a year ago at the Kansas City Convention. Today, %Proportioneers% packaged Amm-O-Feeders have replaced previous ammoniation methods in hundreds of plants—and the method has proven sound.

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%Proportioneers% Chemical Feeders are successfully handling "Burn-Point" and dechlorination jobs for taste and odor control.

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We almost had to be magacians to put out a dependable machine at $99.00 for domestic installation and tiny water supplies. Today, this unit is generally accepted and has assured chlorination to a formerly neglected group of water supplies.

5 Multi-Control Feeders

Multiple feeding of several chemicals has been standardized so that 2, 3, 4, or more synchronized feeders, "ganged" on one drive mechanism, can be ordered from stock.

6 Helping the Defense Program

It took the war to bring home a proper appreciation of the importance of emergency chemical feeding in the water works field. Plants that complacently went along without standby units, portable main sterilizers and emergency all-purpose chemical feeders viewed today's European water works problem and now are stocking up on portable units.

7 All Hydraulic Chlor-O-Feeder

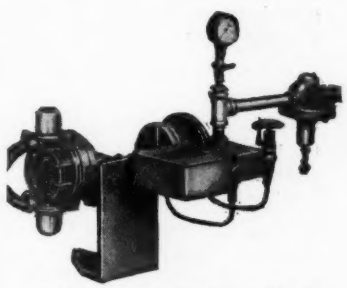
This entirely water driven unit, manually adjustable for any feed, eliminates the need of electric current or gas engine drive.

8 Two Time Treatment (A total defense for swim pools)

This development, of passing interest to water works engineers, represents another forward step in the acceptance of hypo-chlorination and %Proportioneers% units as the best protective method for swim pools and foot bath control.

9 New DeLuxe Chem-O-Feeder

This new DeLuxe All-purpose Chemical Feeder, adjustable while feeding, represents the last word in Chemical Feeder design.



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So it was truly a year of magic — And we haven't stopped yet!

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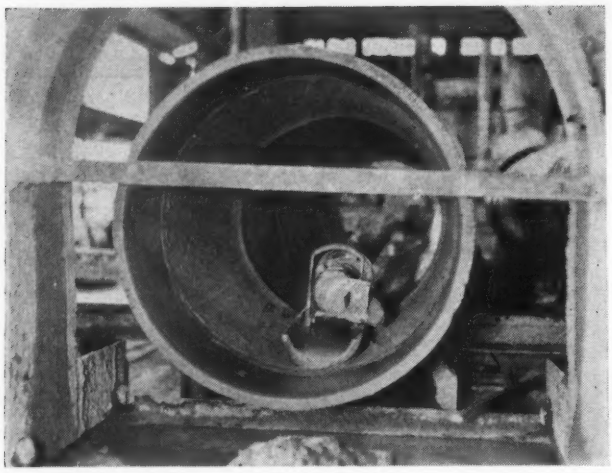


Applying cement lining to 48" Mono-cast pipe by the centrifugal process. Note the troweling action.

being plugged flush with the interior of the main. As in all other methods of lining, the mains are cleaned, removing deposits, corrosion and tubercles, the main being scraped and wire-brushed and a rubber squeegee drawn through several times, leaving it clean and dry. Branches are fitted with special cores and hydrant risers with tapered riser plugs to permit the mortar to line these. Usually one city block is lined at a time, sections of pipe being cut out at each end and a cable pulled through the line.

The lining is about ¼ inch thick, of mortar consisting of 2 parts sand to 1 of cement. Sufficient mortar to line the section completely, with some surplus, is fed into the pipe through the opening at one end and a specially designed liner is pulled through. This pushes the mortar ahead of it and compresses it between the liner and the walls of the pipe at a pressure of about 130 pounds per sq. in., forming a lining that is said to be continuous and uniform in thickness. After 12 hours' curing, the plugs in the service holes, branches and hydrant risers are removed and the openings trimmed of extraneous cement, the line flushed, and service is restored.

The cost of this method, including cleaning, lining, excavation, auxiliary service, reconnecting, resurfacing and overhead, is about one-fourth to one-third the cost of replacement of small lines and should be less in proportion on large lines.

Coefficients of flow on pipe lined in this manner are quite high—normally from 140 to 155, on actual diameters of lining. Based on the nominal diameter of the pipe, which is reduced because of the thickness of the lining, the coefficient of flow is less by an amount that depends on the size of pipe; a 4-inch pipe that is lined will lose a greater proportion of its area than a 12-inch pipe. It is estimated that a 12-inch pipe lined in this manner should have a "C" of 145 for actual diameter and of 130 for nominal, or 12-inch, diameter.

Coating the outside of pipe in place is unusual, but at Everglades, Fla., successfully to prevent rapid corrosion of iron mains by the very corrosive soil, all mains were covered in place with 1" thickness of mortar made with a portland cement containing less than 8% tricalcium aluminate (a type used in Boulder dam), the pipe being suspended from cross timbers and all dirt removed from around it, and the cement applied in forms. At least one pipe company has developed a foundry-applied cement coating.

Bituminous Enamels

Coal tar enamels, which are practically non-absorbent of water, are used in perference to other bitumens for this purpose. Several manufacturers, in addition to furnishing the materials, will arrange with any pipe foundry for the machine application of both interior and exterior coatings, or either, or will advise and assist in the hand coating of large pipes already in place.

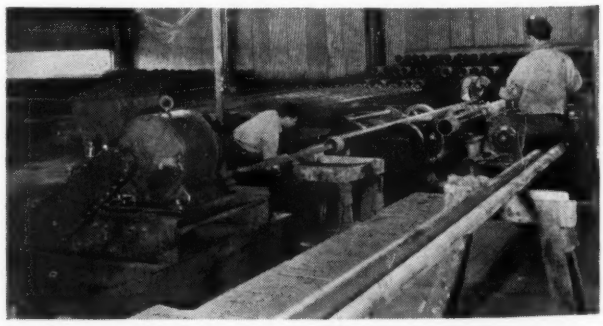
The advantages of the use of enamel-lined pipe include the greater carrying capacity as compared to any unlined iron pipe, due to the smoother interior, and an indefinite retention of this carrying capacity by preventing deposits, tuberculation, etc. Because of these, smaller pipe may generally be installed if they are spun enamel-lined, often resulting in a considerable initial saving in spite of the slight additional cost of the lining, and eliminating future expenditures for cleaning. Also, "red water" and similar troubles are eliminated.

Whereas the coefficient "C" for new tar-dipped cast iron pipe less than 16 ins. in size is generally taken as 125, the coefficient for spun enamel-lined pipe of the same size has been found to be as high as 145. A coated 30-inch line was laid in Pennsylvania in 1932, at which time tests showed a value of "C" of 143.5 to 145.6. Tests made in 1940 showed that there had been no deterioration in carrying capacity and that "C" is still in excess of 140. A test on a 6⅝" (O.D.) line in Ohio showed the very high coefficient of 155.

Because the flow through a properly enamel-lined pipe is not subject to decrease due to corrosion and tuberculation, a value of "C" of about 140 or 145 can be adopted in design instead of the value of 100 ordinarily assumed for the usual tar-dipped pipe. Since the flow capacity is directly proportional to the value of "C," a properly lined pipe may be assumed to have a capacity about 40% greater than an unlined pipe on the basis of assumed conditions in 20 years.

Application of Enamel to New Pipe Interiors.—The composition and physical properties of the enamel used are of great importance and unless unusual opportunities exist for testing and these are combined with an expert knowledge of the subject, it is desirable to use material made by a recognized and reliable manufacturer. Of equal importance is the proper application of the enamel. This involves three distinct phases: (1) Thorough cleaning and preparation of the surface, removing dirt, grease, oil and loose mill scale; (2) priming the prepared metal surface; and (3) applying the enamel. Most pipe producers utilize the centrifugal process for interior linings of small or moderate-sized pipe. The thickness of the lining, which is controlled by the rate of application of the bitumen, is normally 2/32 to 3/32 of an inch.

It is most important that the full thickness of the enamel cover the entire surface of the pipe. A small uncoated spot, even a pin hole, may permit corrosion or tuberculation at that spot. The surest way to detect



Cement-lining pipe by U. S. Pipe & Foundry Co.; May, 1941.

"holidays" (small spots inadequately coated) is by use of the electrical flaw detector, which consists of passing over the coated surface a wire brush which receives not over 10,000 volts of electric current at low amperage.

Applying Enamel to Large Pipe in Place.—Pipe that is large enough for men to enter has been reconditioned so successfully in some cases as to have a greater carrying capacity after relining than it had when first constructed. Lining such large pipe, which often has access openings hundreds or even thousands of feet apart, involves special problems in ventilation, cleaning, internal condensation of moisture (the enamel must be applied to a dry surface), handling of materials, and proper application.

Cleaning the surface, removing tubercules and otherwise preparing it for lining is performed by scraping, wire brushing and sand blasting, drying if necessary and immediately applying a primer, to be followed, after the primer has dried, by the enamel itself, application of which is usually by hand brushing, using two or more coats to avoid pinholes. In general, work of this nature should be planned and carried out only by those enamel manufacturers that specialize in work of this type. As compared to the cost of replacement, such relining involves a very small expenditure.

Lining Small Pipe.—No method has yet been developed for applying bituminous lining to small pipe in place. (Cement lining in place is described later.) However, methods have been worked out for cleaning and lining, in water works yards, old pipe that has been dug up. Also new pipe may be lined by water works employees by these methods. This procedure permits the utilization of local water department labor and very simple equipment. Some manufacturers of bituminous enamels provide the necessary equipment and, when needed, supervisory personnel to instruct water department employees in the lining procedure.

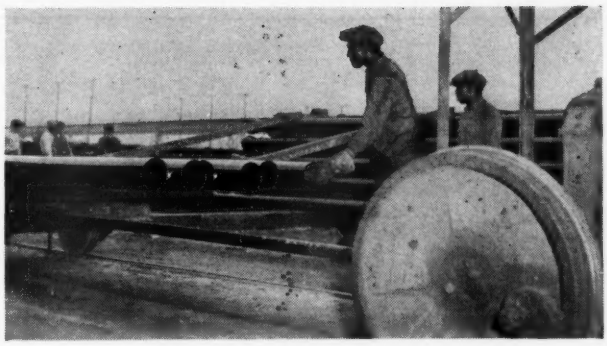
Exterior Coating

It is believed that a considerable percentage of the pipe line footage in this country lies in soils that are not especially corrosive. However, some pipe has been laid in soils or filled ground which are more or less highly corrosive or productive of electrolytic action, and in such locations exterior protection is needed, especially when steel pipes are used. The extent of protection required depends on local conditions. A single application of enamel about 1/16 inch thick might be sufficient in some cases if complete covering of the surface of the pipe after it was laid could be insured. Sometimes the single application is followed by a bonded asbestos tar-saturated felt wrapping, with a final wrapping of kraft paper for protection in shipping.

In some cases, the exterior of the pipe receives only a priming coat at the works and the enamel coat is applied just before lowering into trench, thus avoiding transportation abrasion. To protect the metal at field joints, these are given an abundant coat of hot enamel after completion.

Pipe that has an exterior coating of enamel must be handled rather carefully. Rubber soled shoes should be worn by anyone walking on the enamel surface. Tools or other heavy objects must not be dropped on the pipe; wide canvas slings should be used for handling it. In transportation, the pipe is carried in padded saddles, so placed that sections of the pipe do not touch each other.

In cold weather, most enamel coatings are more easily chipped. Therefore, under severe weather conditions special care should be taken with pipe that is lined inside or coated outside, both in unloading and handling.



Coal tar dipped cast iron pipe

If enameled pipe has not been wrapped, protection against distortion or abrasion of the coating by the backfill may be obtained by using only sand for all backfill that comes in contact with the pipe.

Treating Water to Prevent Incrustation and Deposits

In the occasional areas where they occur the formation of corrosion or of deposits in pipe lines can, to a large extent, be reduced or prevented by controlling the character of the water or by adding small amounts of certain chemicals. In some cases, it is even possible to remove certain types of deposits that have already been formed, such as calcium carbonate incrustations; but it is generally better to rely on mechanical cleaning to return the pipes to their original condition, and then prevent further deposits by proper chemical control.

There are three general methods in use. One is the control of the pH alkalinity and carbon dioxide content of the water; another involves the use of sodium silicate to form and maintain a lining on the interior of the pipe; and the third utilizes a chemical that nullifies the tendency of the calcium carbonate to form deposits.

The corrosiveness of a water depends upon two principal factors: the relationship between the pH and alkalinity, and the relationship between the free carbon dioxide content and alkalinity. The addition of lime or sodium carbonate (soda ash) to the water will modify these relationships. Thus, by means of the addition of alkalis to the water or, in certain cases, by the addition of carbon dioxide, it is possible (a) to dissolve a calcium carbonate coating already placed; (b) to deposit a carbonate coating on the pipe walls; or (c) to maintain the water at such a condition that neither of these will happen.

The relationship between corrosion, alkalinity and carbon dioxide content is shown in Chart 1. The alkalinity of the water and its content of carbon dioxide can be determined according to standard methods and the results plotted on this chart to determine its tendency to corrode the pipe. If, for instance, the carbon dioxide content is 10 p.p.m. and the alkalinity is 80 p.p.m., the use of Chart 1 will show that the water is seriously corrosive. However, if the analysis shows that the carbon dioxide content is 5 p.p.m. and the alkalinity 125 p.p.m., corrosion will not take place.

The relationship between pH, alkalinity and corrosion or deposition of a calcium carbonate deposit on the interior of the pipe is shown in Chart 2. A determination of the pH value of the water and of its alkalinity is made and the results plotted on this chart to determine if the water is of such character as to cause corrosion of the pipe, or if it will deposit car-

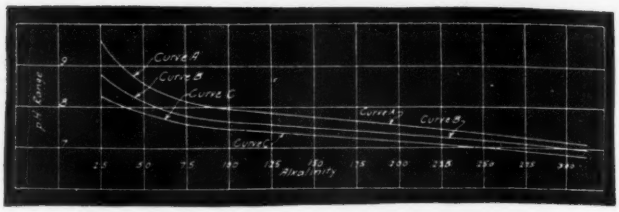


Chart 1—Relation between corrosion, alkalinity and Co_2.

bonate and tend to clog the pipe. If, for instance, an examination of the water shows that the pH is 7.4 and the alkalinity is 100 p.p.m., a slight tendency toward corrosion will be noted. But if the pH is 8.0 and the alkalinity is 100, there will be no corrosion; instead there will be a tendency to deposit a slight amount of calcium carbonate.

Thus by modifying these characteristics of the water a considerable degree of control over its effect on the distribution system can be maintained. The tests involved are simple and application of the lime (which is the substance usually utilized for correcting these conditions) is not difficult. However, if the principles outlined above are incorrectly applied not much good will be accomplished by use of lime.

Under the conditions described, the amount of lime required can be determined easily. When the amount of free carbon dioxide is known, as in Chart 1, computations are made as follows: Assuming a carbon dioxide content of 10 p.p.m. and an alkalinity of 80 p.p.m.: the free CO_2 is 10 p.p.m.; the half-bound CO_2 is 44% of the alkalinity. The total

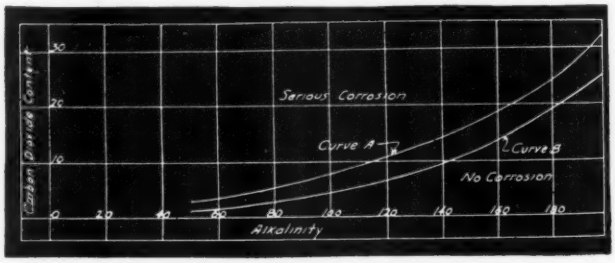


Chart 2—Relations between pH, alkalinity and corrosion.

CO_2 to be neutralized (if it is desired to reduce CO_2 to zero), will be $10 + (90 \times 44) = 49.6$ p.p.m. If lime is used that has an 88% CaO content, 1 p.p.m. of lime will react with 0.7 p.p.m. of CO_2; and the lime required will be $49.6 + 0.7 = 71$ p.p.m. or $71 \times 8.3 = 589$ pounds per million gallons of water.

When the pH and alkalinity are known, a lime solution may be added to a sample of the water and the pH and alkalinity determined from time to time until these characteristics of the treated sample, when plotted on Chart 2, fall between the curves A and B. To make a lime solution, add 10 grams of lime to 1 liter of distilled water; one milliliter or c.c. of this solution added to 1 liter of the water to be tested equals a dosage of 10 p.p.m., or 83 pounds per million gallons. Test the water for pH and alkalinity and plot these on Chart 2 as directed above.

When the pH and alkalinity of the water, when plotted on Chart 2, lie well above curve A, deposits of calcium carbonate will occur in the distribution system. For instance, with a pH of 8.5 and an alkalinity of 150 p.p.m., a considerable carbonate coating may be applied. In this case, correction is accomplished by adding carbon dioxide, or recarbonating the water, thus converting the carbonate into bicarbonate. About 4½ lb. of carbon dioxide is required per million gal-

YOU CAN RECONDITION OLD PIPE LINES WITH BITUMASTIC ENAMEL

With priorities looming for many materials, it is more important than ever to get full use of existing facilities. BITUMASTIC is the performance-proven coating and lining material to preserve your pipe lines and maintain their full capacity.

BITUMASTIC can point to numerous records of 10, 15, and 25 years of satisfactory service in such cities as New York, Baltimore, Providence, and many, many others.

LEFT: Jersey City, N. J. Reconditioning old 72" steel pipe line. Cleaning inside preparatory to coating with Bitumastic Primer and Bitumastic Regular Enamel. Notice tuberculation on top and how well the pipe has been cleaned.

BELOW: New York City. Application of Bitumastic Enamel as last step in reconditioning old 72" steel pipe line. Total length of line, about 25 miles.

Lining Large Diameter Pipe in Place

Often old steel mains with as much as 40 years of service behind them can be reconditioned with Bitumastic and another 30 or 40 years or more of service safely assured. This makes them practically as serviceable as new once more at only a fraction of the cost of a replacement line.

Even this expense will be quickly returned in the increased carrying capacity, and the reduction of power cost if the line is a force main, and the reduction in depreciation of the old pipe.

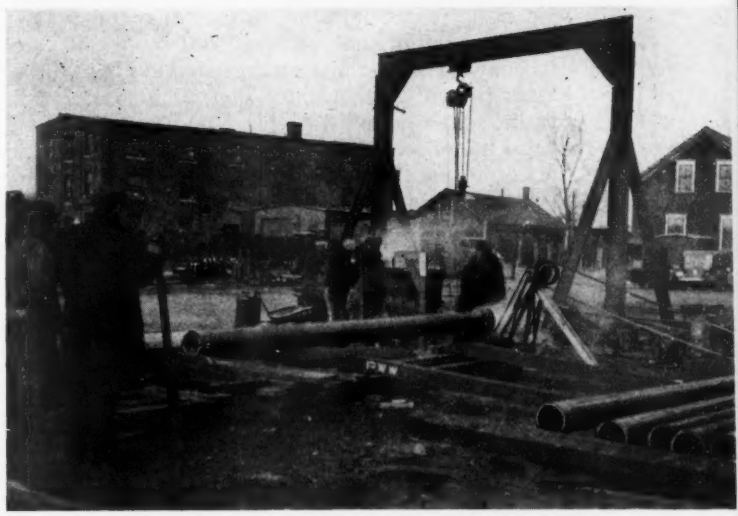
Special problems are, of course, involved which Wailes Dove-Hermiston is best fitted to solve. Correspondence is invited.

Small Diameter Pipe Lining

It is often the practice to remove old cast iron distribution lines which have lost considerable carrying capacity because of tuberculation and replace with other pipe. This provides a chance to reline pipe in the storage yard and later relay it at some other location as a replacement for other tuberculated pipe.

The pipe can be relined and relaid with complete assurance that the carrying capacity not only has been restored but that it will be maintained against future tuberculation or corrosion.

Wailes Dove-Hermiston Corporation furnishes materials, equipment, and experienced supervisors at a nominal fee to train your personnel; thus keeping labor and labor costs at a minimum. Write our nearest office.



ABOVE: Providence, R. I. Lining by water department employees of old cast iron pipe with Bitumastic 70-B Enamel. In 1937 1,200' of twin 60" steel lines originally coated with some other coating that failed were reconditioned with Bitumastic Enamel.

USE BITUMASTIC FOR SEWAGE DISPOSAL PLANT AND TRUNK SEWER LINE PROTECTION

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Norton porous tube, used for recarbonating.

lons of water per part per million of carbonate to be removed. The carbon dioxide is usually produced by burning coke, and is applied to the water by means of a perforated pipe grid placed in a basin.

Recarbonation requires careful design and operation. If too much carbon dioxide is applied, the water will be corrosive; if too little, carbonate deposits may form.

The carbonic acid content of water can be reduced by spraying or other forms of aeration. Aeration also changes iron in solution into an insoluble form, permitting its removal by sedimentation or filtration.

Stabilization.—The addition of a small amount of sodium hexametaphosphate to waters containing a moderate excess of calcium carbonate inhibits the deposit of incrustations in the pipe. This treatment also appears to have a marked inhibitive action on the corrosion of iron and steel. It does not change the pH of the water and acts independently of it and of the alkalinity. It is valuable in treatment plants as it permits coagulation at the most desirable pH and still prevents after precipitation.

Sodium hexametaphosphate is relatively easy to apply, being non-corrosive; and can be fed with any good solution feeder. The usual dosage is ½ to 2 p.p.m., depending upon the character of the water. It does not appear that the stabilizing effect is permanent, but it is stated that a concentration of 2 p.p.m. will prevent precipitation for 5 days or longer in waters containing as much as 200 p.p.m. of calcium carbonate. This permits an operator to maintain much higher pH values than those shown on Chart 2 without causing deposits.

The use of sodium hexametaphosphate permits addition of enough lime or soda ash to increase the pH to such a point that corrosion is greatly reduced or eliminated. The addition of 1 part per million of this chemical has been found to be effective in enabling the operator to maintain pH values up to 9.5 or even higher.

When hard water supplies are softened by lime or lime-soda processes, treatment with metaphosphate is especially desirable. Softening with lime is best accomplished at a high pH, using the excess lime method to obtain a complete reaction, and unless recarbonated or otherwise treated, calcium carbonate deposits may occur in the filter or in the main. Where hard water supplies are not softened, some scale may be deposited; this is especially the case in boilers and hot water heaters. The maintenance of 1 to 2 p.p.m. of metaphosphate in such waters may be advantageous, though it may not eliminate the formation of scale entirely.

Metaphosphate has also been used successfully in cases where iron, either contained in the water or taken up from the mains by corrosion has interfered with dyeing plants. In some cases, the use of this chemical has at first resulted in the sloughing off of some of the carbonate deposits previously deposited, these being removed by flushing. Within a short time, stabilization appears to take place, with prevention of corrosion.

Sodium Silicate Control.—The addition of sodium silicate to water builds up a non-permanent film on the interior of the pipe. This film appears to be built up rather slowly, requiring at least a month with an application of about 8 p.p.m. of SiO_2. Larger amounts of silica would probably increase the rate of placement of the film, but would also probably cause red water by the quick removal of the corroded material already formed on the inside of the pipe. When the feeding of the silicate is discontinued, the protective coating is gradually absorbed. To maintain a coating that has been formed, continued application of the silica at the rate of 4 p.p.m. is necessary.

Among the advantages of silicate treatment are: (1) it does not increase hardness; (2) it is not necessary to maintain high pH values; (3) there is no danger of forming a deposit that is too thick; and (4) analysis of the water to control the amount of silicate applied is not necessary.

Selection of the type of silicate depends somewhat on the type of water. For almost all waters, the best silicate to use is one with a $Na_2O:SiO_2$ ratio of 1:3.2. This material is satisfactory for all waters having a pH above 6.0. A more alkaline silicate, in which the ratio is $Na_2O:2SiO_2$, is recommended for waters with a pH of 6 or below. The more alkaline silicate tends to remove the products of former corrosion more rapidly and if the dosage is not carefully controlled may cause objectionable red water due to these materials. While this can be avoided it is always desirable to clean the pipes mechanically before starting to apply the silicate if the water is to be used in textile and paper mills or similar plants.

The method of feeding should be such that a uniform rate of application is maintained. This may be accomplished by the use of synchronized proportional feeders, or by a feeder actuated by a meter or water wheel.

Lead, galvanized, brass and other metal pipe, as well as iron, are protected by sodium silicate. It is probably the cheapest method where the water is of very low hardness.

Softening Difficulties.—Softening of water by the lime and soda ash process often results in after-deposits of lime on pipes, meters and filter sand unless the softened water be recarbonated, for which purpose carbon dioxide gas is commonly used. This is sometimes obtained from chimneys of near-by furnaces, but more commonly by special combustion apparatus. This apparatus comprises a combustion chamber adapted to mixing the theoretical proportions of air and fuel; a washer or scrubber by which the gas is cleaned and cooled to atmospheric temperature; a drier and a trap for removing water coming over with the gas; a compressor blower for forcing the gas into the water, and provision for diffusing it therein. There should be gauges for indicating (and recording) the amount of gas applied and the percentage of CO_2 in the gas. The fuels most suitable for this purpose are coke, producer gas made from coke, natural gas, artificial gas, fuel oil, kerosene and anthracite.

The diffuser may be a pipe grid, or diffusion plates or tubes ("Aloxite," Norton or "Filtros"), set in the bottom of the channel through which the softened water flows to the filter. A common plan is to set the diffusers in several rows across the channel, providing a series of "curtains" of gas bubbles through which the water flows. In the cases of pipe diffusers, the total

area of the outlet holes should be about 80% of that of the header that brings the gas to the diffuser.

A recarbonating plant, including combustion chamber, cooler-scrubber, compressor, drier and CO_2 flow indicator can be obtained as a complete unit.

Another method of recarbonation recently introduced is "submerged combustion." In this, city gas and air are mixed in the proper proportion and blown to a submerged burner, wherein it is burned and from which the gases of combustion enter the water directly in a finely divided state.

Instead of recarbonating lime-softened water, it is possible to soften without use of lime and thus eliminate the troubles due to after-deposits; this being effected by the zeolite process. In this, the water is passed through a bed of granular zeolite, which absorbs the calcium and magnesium; the zeolite being regenerated with brine when use has caused it to lose its capacity for softening.

Iron Removal.—As already explained, iron in solution (often found in ground waters and sometimes in surface supplies) may cause or aggravate iron-deposits in pipe, and removal of the iron is then desirable. This is commonly effected by either oxidation or zeolite treatment. The former renders most of the iron insoluble and it is then removed by sedimentation and filtration. If there is no carbon dioxide in the water, the amount of air needed is only 0.14 part for each part of iron, and such a small amount can be introduced by sniffling air into the suction pipe of a pump; but this is not sufficient if much CO_2 is present.

Aeration is effected by passing water through the air as a spray, or by agitating it so as to bring all parts into contact with the air, or by passing air in bubbles through it. Various devices and commercial equipment are obtainable for aerating by either of these methods.

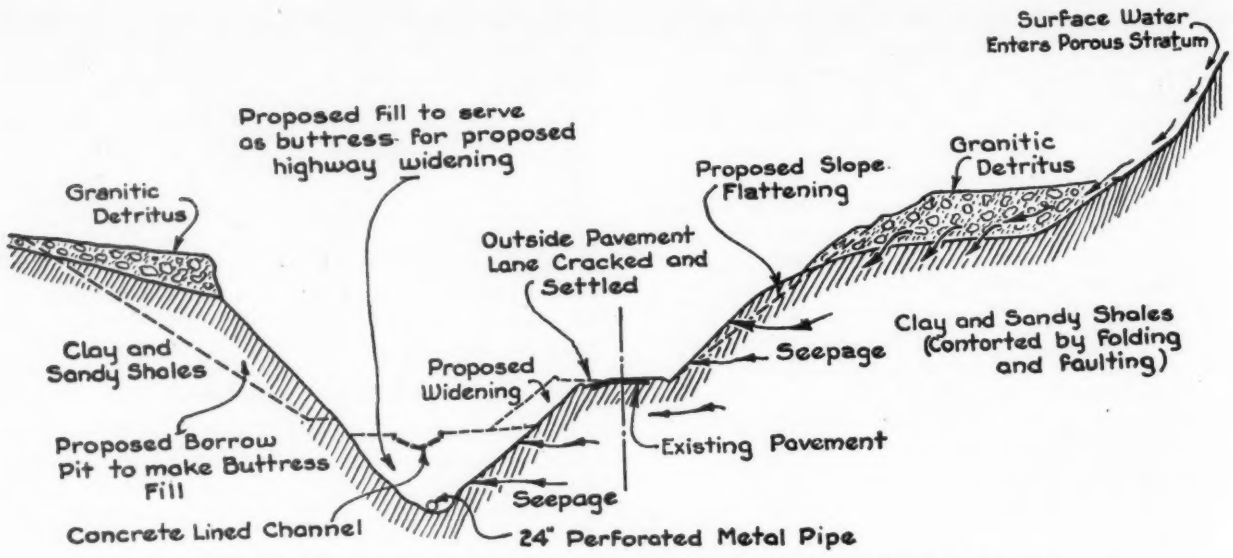
Zeolites remove soluble iron simultaneously with hardness; in fact, will continue to remove it after their hardness-removing capacity begins to fail. Also special zeolites can be obtained for this purpose, with which sodium or potassium permanganate is used for the repeated regeneration instead of salt. When zero-softened water is mixed with unsoftened water to raise the hardness, the latter water can first be freed of iron and manganese by passing through manganese zeolite.

Exterior Corrosion

Corrosion of the exterior of a pipe does not directly affect its carrying capacity; but should such corrosion result in leakage from the pipe, this would reduce the amount of water delivered beyond the leaks, and the pressure there also, in addition to the primary disadvantage of waste of water. This can, in most cases of new pipe, be prevented by exterior coating with bituminous materials or cement, as already described.

Corrosion due to soil has been prevented by surrounding the pipe with a 6" layer of a mixture of sand and lime; this is especially applicable to laying new mains.

Where it is a case of mains already in place, electrolytic corrosion can be prevented by cathodic protection. This is a comparatively recent preventive for water mains, but has been used for many miles of such mains in the west, notable those on "Treasure Island" (San Francisco's World's Fair).



Sketch showing plan for proposed buttress fill and highway widening on Grapevine Canyon.

Sliding Hill Stopped by Buttress Fill and Drain

THE road between Los Angeles and Bakersfield, Calif., carries an average daily traffic of nearly 6,000 cars, and a maximum of over 20,000 has been reached. The inclusion with these of over a thousand trucks and trailers helps to make a serious traffic problem. The worst section for accidents is Grapevine Creek canyon, where there is nearly six miles of continuous 5.5% down grade.

To remedy this condition, a contract was awarded last December for grading this section and widening it to a 4-lane divided highway. This work is made difficult by the fact that hillsides above the road have been settling slowly toward it and threatening to bury it. The hillsides are to be drained and flattened back to stable slopes and the material so removed will be used in widening the roadway embankments. The saturated hillside is to be treated by extensive drainage work in the wet areas above the roadway and by the construction of a buttress fill of over 180,000 cubic yards.

This mass of earth will completely fill the narrow canyon of Grapevine Creek to a depth of about forty feet through the section where hillside movements are occurring. To prevent the possibility of the creek cutting out this fill, a concrete-lined channel with a special spillway at its lower end will be constructed for a distance of nearly two thousand feet, requiring the use of some 3,800 cubic yards of reinforced concrete.

The fill will not only act to brace the moving hillside against the opposite side of the canyon but will also act as a counterweight to balance the earth pressures which now tend to heave or lift the stream bed.

Traffic will be maintained through the work at all times and the construction is to be so handled as to give the least possible interference to the convenience of the traveling public. Three hundred working days are allowed for completion of the contract.

The work of widening the present three-lane pavement to a four-lane divided highway will be handled under a contract to be let after the present project has been completed.

Sliding hill in Grapevine Canyon.

White lines indicate proposed fill construction and highway widening.

Roads for Army Maneuvers

Present plans call for 286,000 motor vehicles in the army by early fall, the number considered necessary for 1,400,000 men. It then will require that one-third the men be either drivers or mechanics of these vehicles. And thousands of miles of roads will be used, and used hard, in the training maneuvers of this force. One armored division, if it all goes out, takes 100 miles of road to get into column. It will keep most highway departments busy this summer to furnish the length, width and durability of surface required to meet this demand.

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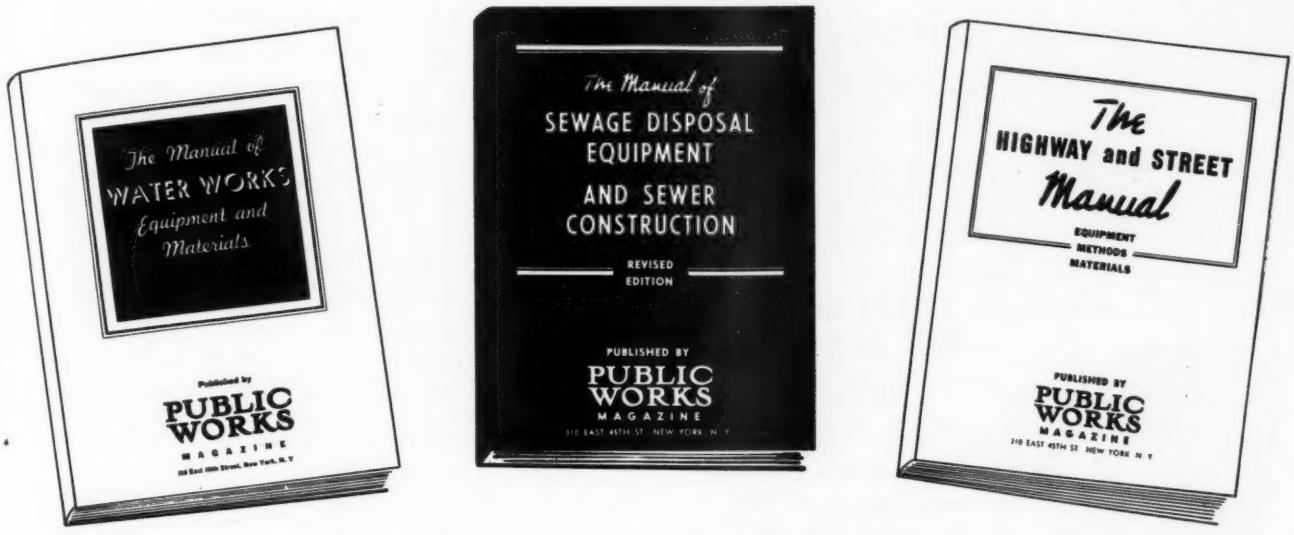

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WPA Assistance

By ROY D. HAMPTON
County Highway Engineer, Fillmore Co., Nebraska

IN THE planning of WPA projects, the first essential is to consider the relief problem and the community which you serve. Here in the West, where we have had a continuation of drouth year after year, our towns have small populations and the counties are the principal sponsors of WPA projects. Naturally, one must plan projects from which the people in the community in question will derive the most benefit, taking in consideration at the same time the proper financing by the sponsor.

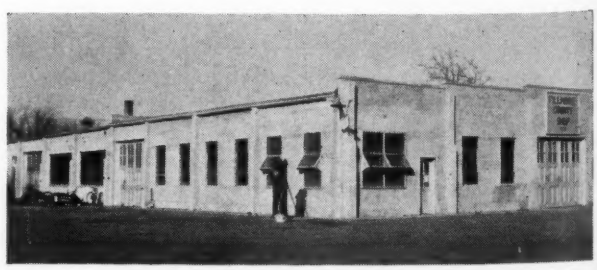
In our county there are three principal types of projects: The building of farm-to-market roads; the building of bridges and small drainage structures; and the production of washed gravel for surfacing improved roads.

For several years we went in heavily for the construction of farm-to-market roads, until now, out of 1,164 miles of roads in our county, 28% of this mileage has been graded and surfaced. No section corner is farther than two miles from an all-weather road.

Two years ago we began to realize that our road building activities were not balanced in accord with the present theory of WPA for the following reasons: You can obtain WPA aid for construction but not for maintenance, and after a certain amount of gravel surfacing has been placed on new roads, then the construction point ends and one arrives at maintenance, on which, at least in our territory, we have been unable to receive any assistance from WPA.

We have found that the maintenance cost of keeping up certain types of roads will reach a point where it absorbs all of the revenue. Consequently, in our case we had to give our attention to the development of another type of WPA construction. The type of construction that we turned to more strongly than we had in the past was the construction of bridges and drainage structures, and about two years ago we centered our WPA proposals on construction of steel and concrete bridges and culverts which we have found costs much less from a maintenance standpoint. In other words, a steel or concrete bridge can be painted every four years at a small maintenance cost in comparison to the maintenance of five miles of road.

During this time we have been able to use WPA assistance on maintenance of gravel roads in the following way: About five years ago we discontinued the contracting of our gravel surfacing and resurfac-



Fillmore County shop, 140 ft. long by 50 ft. wide; cement floor; steam heat.

Adjusted to Highway Needs

Type of construction selected that requires minimum expenditure for maintenance. Aid in maintenance obtained by using gravel from County-owned pits.

Roy D. Hampton.

ing and went into gravel production ourselves. We did this by buying our own pumping equipment, buying our own trucks and instead of paying yard royalty on gravel, we purchased land on which gravel pits could be located. This has been done gradually until at this time we now own three good gravel pits in our county, which are located in different parts of the county in order to cut the distributing haul. As these pits were purchased we were able to utilize WPA funds and labor in developing them. On several of these locations we removed 25,000 to 35,000 yards of over burden. We were also able to use WPA labor in assisting in setting up equipment and as drivers on our gravel trucks. However, we had found it necessary to place county operators on our pumping and heavy grading equipment, WPA not being able to furnish experienced operators.

It has been our experience through the last several years that, in working directly with WPA labor, it is desirable to try to work in a certain amount of equipment. We have found that you cannot go back to the old Chinese way of doing things, neither can you go all modern, but you have to hit the middle between both extremes. If you get too much equipment on WPA projects, you naturally eliminate the thing for which it was intended—making hand work for men. If, on the other hand, you try to do it all by hand, the average American gets disgusted because he does not seem to be accomplishing anything.

We feel that WPA has been a necessity in our Western country. We also feel that we have received many benefits from this labor being directed along lines from which the tax payer will derive a benefit.

Our county shop building was partly built with WPA labor and funds. It is 140 feet long and 50 feet wide; has a concrete floor and steam heating system, and is equipped with electric and acetylene welders, heavy-duty blacksmith equipment, lathe, tools, overhead crane, and etc. This shop has saved our county thousands of dollars in the maintenance of our equipment. WPA equipment gets pretty hard usage for two reasons: One of them is, that the men are in-

experienced, the other, that we are trying to do work at a time of the year when conditions are adverse for road or other construction purposes. To me, it is as essential for the County Highway Department to have a modern shop for the maintenance and care of the equipment as it is for a railroad to have a roundhouse.

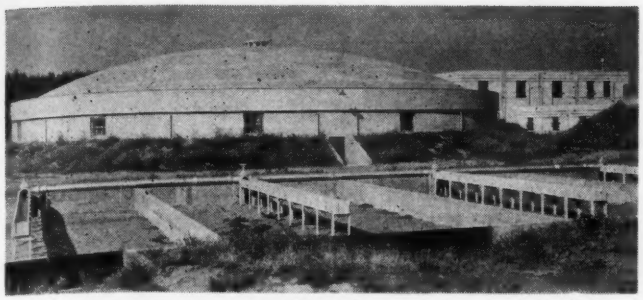
We run the County Highway Department on practically the same basis that any private business would be run. We keep a record of everything that is done and of the cost of same. Our present inventory of equipment and material is $88,000. I have one motto in running a County Highway Department, and that is to spend the public's money just the same as if it were coming out of my own pocket.

Submersible Bridges in the British Commonwealth

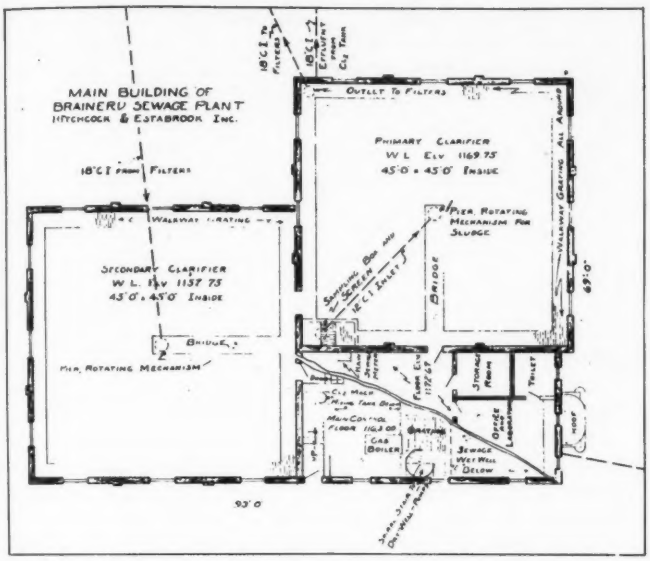
Submersible bridges are used in India, Australia and Africa, where many of the larger rivers are liable to sudden floods during the rainy season. Since traffic over a submersible bridge is interrupted for relatively short periods only, it is often more advantageous to provide a structure of this type than to build a high-level bridge of considerably greater length. Sites where the approaches are on embankment are usually unsuitable. The submersible bridge must support the normal dead load and traffic load and must be capable in addition of withstanding a considerable horizontal thrust and possibly an upward lift from the flood water; the amount of scour is also likely to be very great. The period of maximum stress occurs when the water is just above bridge level. An approximate method of calculating frictional stress and the stresses due to static head of water, current pressure, and eddies, and of determining the uplift under the slab, is illustrated by a numerical example. Special attention is paid to the design of the pier foundations and the shape of the piers themselves. The upstream end of the piers should preferably be rounded and the downstream end tapered. This design minimizes the formation of eddies, whilst the resistance offered by the rounded upstream end is no greater than that of a pier tapered at both ends. If railings are provided they must be either collapsible or removable. In some cases a collapsible railing which can be folded flush with the road level into a channel in the deck is used. Superstructures should be sufficiently heavy to prevent their being carried away, while their design should offer the minimum obstruction to flow. The height and length of spans should be sufficient to permit the free passage of floating debris. Materials should be as nearly waterproof as possible, and ornamental work or spaces in which debris might become entangled should be avoided. *"Road Abstracts," Proc. Indian Roads Congress.*

Controlling Cracks in Sheet Asphalt

A method for the prevention of irregular surface cracking in sheet asphalt pavements has been developed by the Rhode Island State Division of Roads and Bridges. Immediately following the laying of the asphalt surface course, and after the initial rolling is completed, a chalk line is snapped on the pavement directly above all crack control plates which are installed in the concrete base course. A heated cutting tool is then run over this guide line to cut in the surface to a depth of about one inch. Following this, a heavy manila paper strip, about ¾ inches wide and of suitable length, is inserted in the freshly cut slot after which the usual rolling operations are continued.



Brainerd sewage treatment plant. Concrete dome covers filter. Hitchcock & Estabrook, engineers.



Main building, Brainerd, Minnesota, sewage treatment plant.

Bridges to Carry Military Vehicles

THE limitations imposed by Army Regulations on gross weight, width, height and axle loads for military vehicles have recently been revised and now agree generally with those recommended by the American Association of State Highway Officials and adopted by several states. For example, the allowable gross weight for military vehicles is determined by the familiar formula $W=C\ (L+40)$. It should be mentioned, however, that these limitations on the weights and dimensions of military vehicles are not used as police measures, as they are in the various states, to keep unsafe vehicles from using the roads and bridges, but are used to govern the design of military transportation. They discourage the development and adoption of large, heavy vehicles for military use. The object sought is to have in the Army, insofar as possible, only those vehicles which can use the existing roads and bridges in this country and which will not impose on the military engineers duties impossible of performance in time of war.

If these limitations could be applied without exception to military vehicles the road and bridge problem would be simplified. There are exceptions, however. Tanks and some gun-prime-mover combinations exceed the limitations of many states. This is unavoidable. Fighting vehicles and artillery must be able to perform their combat functions or else they are use-

less. More efficient antitank guns make more armor necessary on the tanks and hence the weight goes up. Before a vehicle exceeding any of the general limitations is allowed, the need therefor and the effect of the vehicle on roads and bridges are carefully studied. The vehicles exceeding the limitations are few, however, and it should be emphasized again that army vehicles are similar to commercial vehicles. In fact, the army uses commercial vehicles—the same trucks, semi-trailers, tractors and other vehicles which are using the roads every day. Obviously the same types of roads and bridges desirable for commercial traffic are needed for a large proportion of our military vehicles.

I said that tanks and some other military vehicles exceeded the limitations on weight, axle loads and dimensions which are prescribed by Army Regulations and those adopted by many states. You may, therefore, question the adequacy of the requirements for military transport set up for the strategic system, particularly the requirement for H-15 bridges. The Public Roads Administration has recently conducted an investigation of the adequacy of bridges for military loads. Some wheeled vehicles now in use in the army, particularly heavy semi-trailer outfits, do cause overstresses in H-15 bridges, but these overstresses are within the usually assumed tolerance for overloads. Also, such loads are relatively few among the other military vehicles. Regarding tanks, it was concluded that standard H-15 bridges could carry our tanks although there would have to be regulations as to the number of lines of tanks, their spacing and their speed, in the case of the heavier tanks. The stresses induced by tank loadings on bridges are not so severe as those induced by motor truck loadings, since the load is distributed to more points, thus approaching a uniform load and also reducing impact.

Thus it appears that new, standard H-15 bridges are adequate to carry present military loads. However, we may have heavier tanks in the future—and depreciation caused by rust, rot, etc., will reduce the design rating. Also remember that restrictions on how the heavier tanks pass over bridges are necessary and that such restrictions are undesirable. Consequently, although the requirement is now for H-15 bridges on the strategic highways, it is perhaps not too soon for the War Department and the Public Roads Administration to reconsider this requirement. Speaking before the annual convention of the American Association of State Highway Officials, Mr. Brandt, the Superintendent of Public Works in New York State, pointed out that New York is now building H-20 bridges on all routes; that the average H-20 bridge costs only 10 per cent more than an H-15 bridge; and that the H-20 bridge will more than pay for its extra cost through its longer life even on roads which will never carry loads in excess of 15 tons. That should give us all something to consider seriously before we continue building to the H-15 loading. Mr. Brandt further pointed out that weak bridges render otherwise suitable roads useless for military purposes and warned all highway departments to look *first* to their bridges. I think that is sound advice and recent maneuvers in some parts of the country have confirmed the warning. In 1939 it was desired to move one 155 mm gun from one large army post to another, but it was found that there were some bridges, on any route which could be used, which were not safe for that load, so the gun could not be moved by highway. *(From a paper by Capt. Wm. C. Baker, Jr., Corps of Engineers, U. S. A., before the National Asphalt Conference.)*

Legislative Study of Highway Matters

A development of great interest to highway users is the increasing legislative resort to study committees and commissions empowered to recommend legislation based on their findings. A complete study of for-hire motor vehicle legislation has been authorized by the Oregon Legislature. In Indiana, a commission has been set up by legislative action to survey the highway system and means of financing the same.

The Oklahoma House created a special committee to study all the different statutes relating to fees, licenses and special funds. The New York Legislature has sent to the Governor a measure directing study of the distribution of gas tax revenues to localities. Investigation of the use made by counties of state highway funds is provided in a pending Pennsylvania resolution.

The West Virginia Legislature provided for a study of highway safety and the North Carolina Legislature directed a study of compulsory inspection laws.

A California resolution would create a committee to study highway costs and the equitable distribution of highway user taxes between various classes of motor vehicles. Measures in Wisconsin for a road program study committee and in Massachusetts for a study of truck transportation are still pending.

Service Charges for Refuse Collection Legal

The use of service charges to finance municipal refuse collection and disposal operations was upheld recently in the Florida Supreme Court in a case involving the city of Miami and a householder who refused to pay the annual four dollar service charge and yet desired the service. In giving its decision, the court agreed that the municipality should collect and dispose of the refuse its citizens accumulate, on the ground that public health is served thereby. However, the court added, "city fathers are possessed of no magic by which they can extract from the elements or some other intangible source the means to support new burdens as they arise." The court ruled "the means may be raised by direct or some other species of tax, but it must be extracted from the people and should be spread to require all who enjoy the service to aid in bearing the burden."

Miami found it necessary to establish a system of service charges to finance this municipal service soon after the state passed the homestead tax exemption amendment which removed much of the municipal tax base.

Stearns County Experiments With Calcium Chloride Stabilization

(Continued from page 26)

struction of a higher class of surfacing, namely, a bituminous course. Allowing traffic to use a stabilized grade for a year or two will increase compaction, uncover weak points of the grade, especially on new construction, and may perhaps economically serve traffic for a longer period of time than originally estimated.

Our activities in 1941 will be confined principally to the stabilization and treatment of the county roads leading through our small communities, where favorable reaction to this type of surfacing is immediate. Utilization of local materials, adaptation of ordinary county equipment to the construction, the simple method of treatment and the low cost of maintenance blading are factors which appeal to the local highway user and the taxpayer.

Operators Wanted for Army Sewage and Water Plants

THE operating and supervising personnel needed in connection with the water supply and sewerage of camps, forts, cantonments and other army posts is the subject of a report prepared by the Water, Sewer, Gas and Electric Section, Repairs and Utilities Branch, Office of the Quartermaster General, in which recommendations are made as to number, classification and qualifications. Although these positions will be under Civil Service, many of the specialized qualifications are not included in present Civil Service Classification lists.

Both water and sewage plants are classified according to size and type of treatment, into four groups —Class A, B, C and D—each having distinct personnel requirements.

Water Supply Plants

Class A. Those treating surface water by chemical coagulation and filtration and serving 20,000 men or more; or the same treatment with lime softening in addition, serving 10,000 or more.

Personnel: Superintendent, chemist, 4 filter operators; one operating and 3 assistant operating engineers on pumps; and one laborer. Qualifications for superintendent or supervising engineer are: *Education.*—Four years of college training, preferably in engineering. Two years of experience in water treatment, preferably supplemented by attendance at state short course schools, may be substituted for each year of college training, but shall be in addition to experience qualifications as outlined below. *Experience.*—Five years' experience in water treatment or related fields, four of which shall be active charge of a Class B water treatment plant, *or* subordinate position or responsibility in a Class A water treatment plant. Experience in sanitary engineering, design, research, or equipment may be substituted for a portion of the above operating experience. Salary is $3,200.

Chemist.—Four years of college education in chemistry and bacteriology, chemical, or sanitary engineering; or two years of experience in chemical and bacteriological analysis of water may be substituted for each year of college training. Salary $2,000.

Filter Operators.—High school education, with two years' experience in water treatment as filter operators, with a practical knowledge of methods of operation and control of water treatment. Two years' experience may be substituted for each year of high school. Where experienced filter operators are unobtainable, high school graduates with a year or two of satisfactory industrial experience, and with initiative and mechanical ability, may be used, at a lower starting salary. Salary, $1,500.

Operating Engineer, Pumps or Filter Operator and Operating Engineer, Pumps.—High school education, with two years' experience in water treatment as filter and pump operators, with a practical knowledge of methods of operation and control of water treatment. Practical experience in operation and maintenance of electrically and gasoline driven pumps, such as deep-well turbine pumps, centrifugal booster pumps, air compressors and air lifts, and automatic and manual equipment pertaining to same. Salary, $1,680.

Assistant Operating Engineer, Pumps.—Pracical experience in operation and maintenance of electrically and gasoline driven pumps, such as deep-well turbine pumps, centrifugal booster pumps, air compressors and air lifts, and automatic and manual equipment pertaining to same, or in related mechanical fields. Salary, $1,500.

Assistant Filter Operator and Operating Engineer, Pumps.—Qualifications similar to Filter Operator and Operating Engineer, Pumps, at $1,680, except that where experienced men are unobtainable, high school graduates with a year or two of satisfactory industrial experience, and with initiative and mechanical ability, may be used, at a lower starting salary. Salary, $1,500.

Class B Plants. Those treating surface water by chemical coagulation and filtration in the population range of 5,000 to 20,000. *Personnel:* Superintendent; chemist (shared with the sewage plant if possible); filter operator and operating engineer of pumps, with 3 assistants; and laborer. Qualification for superintendent or supervising engineer are: *Education and Experience:* Four years college training, preferably in engineering, with three years' experience in water treatment or related fields, two of which shall be in a subordinate position of responsibility in a Class A or B water treatment plant: or, two years of experience in water treatment, preferably supplemented by attendance at state short courses, may be substituted for each year of college training, and shall be in addition to the three years of responsible experience as outlined above. Experience in sanitary engineering, design, research, or equipment may be substituted for a portion of the above operating experience. Salary, $2,600.

Qualifications for other positions as above.

Class C Plants. Those that serve a population of 5,000 or over and (a) purchase water and have elevated storage and booster pumps; (b) use well water and elevated storage but have no treatment except chlorination; or (c) use well water, with treatment by sedimentation and chlorination and have booster pumps and elevated storage. *Personnel:* Superintendent or supervising engineer and one assistant. Qualifications for Superintendent or Supervising Engineer. —Practical experience in operation and maintenance of electrically and gasoline driven pumps, such as deep-well turbine pumps, centrifugal booster pumps, air compressors and air lifts, and automatic and manual equipment pertaining to same. Salary, $1,680.

Class D Plants include all systems with population over 5,000 using purchased water, without booster pumps. No operating personnel will be provided.

Sewage Treatment Plants

Class A. Those having pumping stations, primary tanks, separate sludge digestion and chlorination; population 40,000 and over.

Personnel: Superintendent or supervising engineer, four shift operators, one laborer. Qualifications for superintendent or supervising engineer, same as for Class A water supply plants, with "sewage treatment" substituted for "water treatment." Salary, $3,200.

Shift operator; high school education, with two years' experience in sewage treatment as shift operators, with a knowledge of methods of operation and control of sewage treatment. Two years' experience may be substituted for each year of high school. Salary, $1,500. Where experienced shift operators are unobtainable, high school graduates with a year or two of satisfactory industrial experience, and with initiative and mechanical ability, may be used, at a lower starting salary.

Class B. These include (1) Doten or Imhoff tanks with trickling filters, serving 20,000 men or more; (2) settling tanks and separate sludge digestion (primary treatment only), population 20,000 to 40,000; (3) settling tanks, separate sludge digestion, trickling filters or activated sludge, population 10,000 to 20,000.

Personnel: Supervising engineer or superintendent, 2 shift operators, one relief operator, laborers as required. A chemist may be shared with the water plant. Qualifications for supervising engineer or superintendent, same as for Class B water supply plants, with "sewage treatment" substituted for "water treatment." Salary, $2,600. Shift operators as above.

Class C. These include (1) Doten or Imhoff tanks, primary treatment only, 20,000 or more population; (2) Doten or Imhoff tanks with trickling filters, 5,000 to 20,000 population; (3) primary treatment with separate sludge digestion, 5,000 to 20,000 population; (4) primary treatment, separate sludge digestion and trickling filters or activated sludge, 5,000 to 10,000 population.

Personnel: Superintendent or supervising engineer, 2 shift operators and one relief operator and mechanic. Qualifications for superintendent or supervising engineer are: Four years' college education, preferably in engineering or technical training of related nature, and one year experience in subordinate position of responsibility in Class A or B sewage treatment plant, or related experience in sanitary engineering, design, research, or sewage treatment; or, high school education, preferably supplemented by state short courses, and four years' experience in charge of a class D plant, or in a subordinate position of responsibility in Class A. B or C plants. Salary, $2,000.

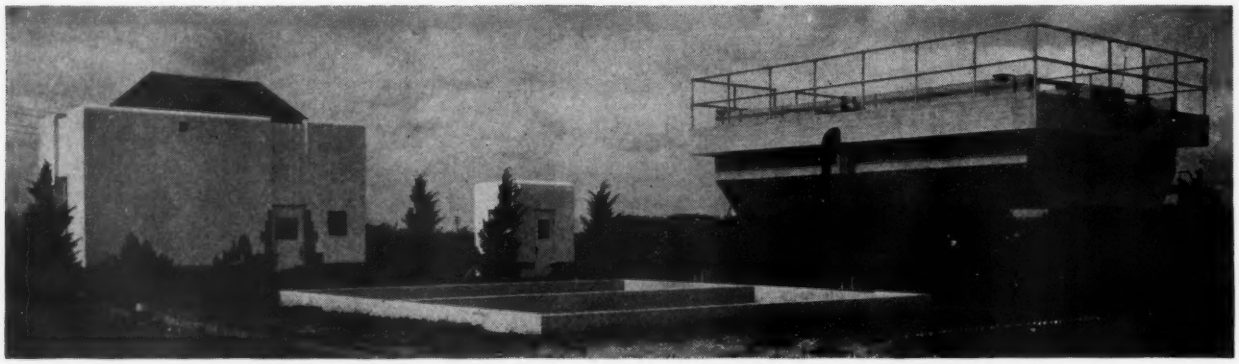
Class D. These include Imhoff or Doten tanks, primary treatment only.

Personnel: Superintendent at $1,680, one relief and semi-skilled operator, and laborers as required. Qualifications for superintendent are: Experience in operating Army Doten or Imhoff tanks, and in operation and maintenance of pumping equipment and bar screens will be required.

Salaries for both water and sewage plant personnel are of the approximate range now paid for similar positions in municipal work for men of the specified qualifications. Consideration should be given to the fact that these men will be called from municipalities where the continuity of their job is assured, and assigned to posts where the position will possibly last for the duration of the present emergency only.

Salary ranges have been kept within Civil Service brackets as far as possible. Classifications are not given, as in most instances the specialized qualifications needed do not fall within present Civil Service classification lists. This is especially true of position of superintendents in the $2,600 and $3,200 brackets.

It is believed that information regarding these appointments can be obtained through your local Civil Service Office. If not, it is suggested that you write the U. S. Civil Service Commission, Washington, D. C., or the Quartermaster General, War Department, Washington, D. C.



Pump house and laboratory of the Rayne, La., sewage treatment plant. Imhoff tank at right.

The Sewerage Digest

The Rutherford Joint Treatment Plant

A joint treatment plant serving Rutherford, East Rutherford and Carlstadt, N. J., began operation last December. The design capacity is 4 mgd. It is fully mechanized and is operated by a superintendent, chemist and 4 shift operators, with a helper when needed. The trunk sewer to the plant is of reinforced concrete pipe in 10 ft. lengths, coated inside and out with bituminous waterproofing. Sewage from the interceptors is measured by four Schofield flumes, and the total flow by a Parshall flume, from which a Chronoflow transmitter controls the feed of coagulants. Sewage passes through 2 Link-Belt bar screens; 4 Fairbanks-Morse horizontal centrifugal pumps controlled by Automatic Controls Co. multipoint switches; a Link-Belt grit collector and screw-type washer; a 24 in. Parshall flume; Link-Belt flash mixer and paddle-type flocculator; primary and secondary clarifiers, each with a Dorrco "Monorake" sludge collector; 4 sprinkling filters with "Armcre" drains and Yeomans-Simplex distributors fed by Yeomans dosing siphons; "Municipal" down-flow sand filters with automatic cleaners; Dorr "Multdigestion" tanks, the primary tank heated and provided with a "Turbomix"; 2 Conkey 8 x 8 ft. vacuum filters to filter digested, raw primary or raw secondary sludge; a Merrick "Weightometer" to weigh the sludge cake; a "Municipal" multihearth incinerator; pre- and post-chlorination, the former using W&T potentiometric control system, proportioning rate of feed to total chlorine demand. Chemicals are elevated to the storage room by a Burwak freight elevator. A Clark Controller Co. control panel contains thermal circuit breakers, start and stop push button stations and on-off switches for operating combination across-the-line starters on 22 drive motors; a Republic indicator and a Leeds & Northrup indicating recorder for regulating sludge dewatering and incinerator operations. The six sewage pumps can be controlled from another station, but normally are controlled automatically by float switches. From raw sewage to secondary clarifier effluent the turbidity is reduced from 204 ppm to 32, suspended solids from 226 ppm to 25, and B.O.D. from 295 ppm to 61.[G14]

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

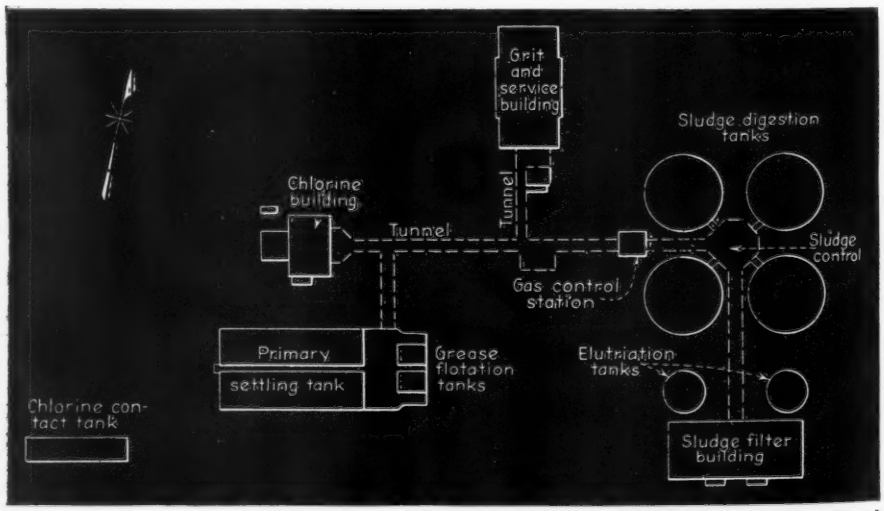
Sewage Treatment At the Anacostia Plant

The Anacostia River 7.5 mgd sewage treatment plant to serve the Washington Suburban Sanitary District, placed in operation last November, provides only for primary treatment although activated sludge treatment is contemplated for the future. It includes automatic screens and screenings grinders, grit collectors and washers, and aero-chlorination for grease flotation; and heated digestion tanks with floating covers, elutriation and chemical conditioning devices, and vacuum filtration equipment. Because of gas hazards, gas pipes are kept out of the principal structures as far as possible, and all gas metering equipment is placed in a small isolated building. Sludge from either the digesters or the elutriation tank is treated with ferric chloride and dewatered on two vacuum filters of 250 sq. ft. each. Sludge cake is delivered by belt to trucks or a storage bin, to be used as fertilizer or incinerated.

Grease flotation prior to sedimentation is effected in a three-pass baffled tank in which air can be bubbled through the sewage. Each tank is divided by round-the-end baffles into three channels 5 ft. wide and 20 ft. long, each containing a row of diffuser plates through which compressed air is fed at the rate of about 0.1 cu. ft. per gal. of sewage, with provision for adding 1 to 3 ppm of chlorine. The floating grease is removed by surface skimmers in the sedimentation tank. The total cost of the project was $796,500.[E11]

Salvaging Tin From Cans

There are only a few detinning plants in the country. If tin cans are not crushed, less than five tons can be carried in a railroad car, making transportation expensive; if they are crushed, it is difficult to move food remnants, labels, etc., preparatory to detinning. There is at most 1.3



Courtesy Engineering News-Record

General layout of plant facilities, the major units of which are connected by access tunnels. Anacostia plant.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 69-71

lb. of tin on 100 lb. of cans. The iron can be melted down for sash weights, or the cans shredded and used in copper mines. It is doubtful if recovery of the tin would be profitable. However, the Washington Suburban Sanitary Dist. nets $7.00 a ton profit by salvaging tin cans.[E10]

Macro-Fauna In a High-Rate Filter

At Huddersfield, England, during 1940 studies were made of the effects of high-rate filtration on the fauna of the filter. The sewage from the distributor arms hit the filter medium (clinker) with such force as to produce a spray and keep the surface scoured. This filter was compared to a standard one. While there were 10 species of fauna breeding in the latter filter, the high-rate filter contained but two—*Psychoda* flies and the beetle *Cercyon haemorrhous*—and a much smaller number of total macro-fauna. It is suggested "that increase in rate of flow with resulting increase in bed-growth and sludge will be accompanied by increase in abundance of macro-organisms until that point is reached at which the rate of accumulation of the former is greater than its pulverization and destruction by the latter. Any increase in rate above this point will result in a decrease in the population, and be followed by clogging of the bed." Under present conditions at Huddersfield the rate of 10 mgad is that above which serious pondage would occur. Closely adhering fungal and bacterial slimes and agglutinous sludge are not likely to be washed out by any flushing action of sewage, which, even in a high-rate filter, only trickles through, but ponding is controllable by use of the scouring organisms.[D10]

Irrigation for Secondary Treatment

The effluent from primary treatment at Bakersfield, Calif., averaging 5.5 mgd, is disposed of by broad irrigation on 600 acres of land used for cattle pasturage. The effluent is practically free of visible suspended solids and no nuisance is created. The primary treatment includes screen and shredder, detritor, Parshall flume, chlorine solution equipment, flocculator-clarifier. Sludge is digested and dried on open beds. Provision is made for treating the sewage ahead of the flocculator-clarifier with ferric chloride for coagulation, but this has not been necessary, more than 80% removal of suspended solids being averaged without it. Digester supernatant is returned to the flocculator, with provision for adding chlorine to it if it disturbs the functioning of the settling tank.[E12]

Gas at the Rock Island Plant

At Rock Island, Ill., sludge gas is collected in floating digestion tank covers, forced by their weight through 3" pipes, meters, a 4" pipe and diaphragm-type check valves into a 6" header to the various equipment. If pressure in the 4" line reaches 4¾ in. water pressure, a switch starts a compressor that forces the gas into two gas holders, until the pressure in the 4" line drops to 3", when the compressor stops. When the pressure in the gas holders reaches 40 lb. per sq. in. a switch opens the circuit so the compressor can not start until this pressure drops to 30 lb., during which period gas produced but not consumed is burned in a waste gas burner. When gas consumption exceeds production, gas from the holders flows into the system through a pressure-reducing valve that maintains a pressure of 3½ in. in the gas main. The gas holders are Hortonspheres 36 ft. diameter, each holding 91,000 cu. ft. at 40 lb. pressure.[H24]

Automatic Operation Of Flexible Plant

The plant at Webster City, Ia., is designed for sewage from 10,000 population, with maximum flow of 1.73 mgd of combined sewage, excess over this going to the river through storm overflows. The sewage is pumped to a primary clarifier by either a 300 gpm, 400 gpm or 500 gpm pump, automatically selected according to the rate of sewage flow; then passes in series through two filters and their secondary clarifiers. If the flow is less than 300 gpm, final effluent is pumped back to the primary clarifier to maintain

a minimum load on the filters of 15 mgad = 300 gpm. If the flow exceeds 500 gpm, two pumps or all three, as may be necessary, go into operation automatically, and the two filters operate in parallel instead of in series. Heating the digester is effected by circulating sludge from it through a heat exchanger and back to the digester, the exchanger containing coils through which is circulated water heated by digester gas.[H26]

Bulking of Activated Sludge

Bulking with domestic sewage free from detectable quantities of carbohydrate wastes is due largely to a deficiency of oxygen created by the slow rate of diffusion of oxygen from the liquid into the floc and the high oxygen demand within the floc. The remedies recommended are: (1) Maintenance of sufficiently high dissolved oxygen in the mixed liquor to allow a high diffusion gradient to the floc. (2) Maintenance of dissolved oxygen not only at the outlet but also throughout the tank, by distributing the sewage load. (3) Maintenance of low sludge concentration in the mixed liquor. (4) Dilution of the sewage with stream water, recirculation of secondary effluents or returning large volumes of activated sludge. (5) Reduction of the high oxygen demand rate during the initial aeration period by careful chlorination of returned sludge or other means.[G15]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

D *The Surveyor*

April 4

10. *p.* The Biology of the Macro-Fauna of a High-Rate Double Filtration Plant at Huddersfield. By T. B. Reynoldson. Pp. 237-240.
11. *p.* Practical Problems of Sewage Works Management. Symposium. Pp. 241-242.

April 18

12. *p.* Discussion of D 10. Pp. 271-272.

E *Engineering News-Record*

May 8

10. Salvaging Tin Cans. P. 67.
11. Sludge Disposal Dominates Plant Design. By H. R. Hall. Pp. 80-82.

May 22

12. Combining Old and New in Sewage Disposal. Pp. 53-54.

G *Water Works & Sewerage*

April

14. A Combination Chemical-Biological Sewage Treatment Plant. By A. B. Kozma. Pp. 141-152.
15. Activated Sludge Bulking. By H. Heukelekian. Pp. 183-185.
16. Plus Fertility Values of Sewage Sludges. By A. M. Rawn. Pp. 186-188.

H *Sewage Works Engineering*

May

24. The Rock Island Gas System. By R. W. Cook. Pp. 262-266.
25. *p.* Textile Waste Treatment. By H. B. Gotaas. Pp. 267-268.
26. Programmed Operation of Webster City, Ia., Plant. By Currie Eng. Co. Pp. 269-271.

J *American City*

May

13. Primary Treatment Plant at Amherst, Mass. By T. R. Kendall. Pp. 36-38.
14. Alley Refuse Collection by Motorcycle Tractor. By G. H. Elliott, Jr. Pp. 54-55.
15. *p.* Sewer Service Charges. By H. F. Smith. Pp. 71, 73, 81.

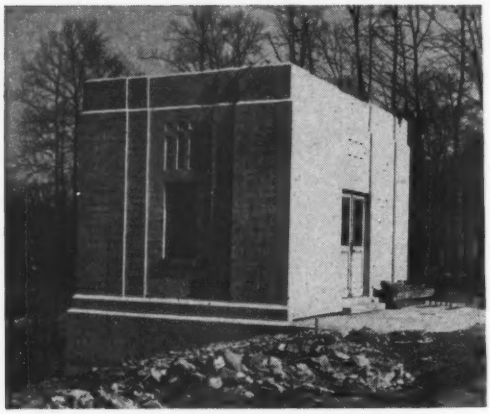
P *Public Works*

May

21. Up-to-Date Sewage Plant for a Small Community. By A. S. Milinowski. Pp. 14-15.
22. Tunneling an 8-Foot Sewer 40 Feet Below the Street. Pp. 21-22.
23. Sewage Treatment at Collinsville, Ill. By J. B. Vigna. P. 22.
24. *n.* Reconditioning 40-Year-Old New York Sewers. P. 22.
25. Suggested Sanitation for an Air Base Garrisoned by 4,000 Men. By A. E. Stilson. Pp. 37-40.

Defraying Expense of Relet Contract

The Illinois Supreme Court holds (Gunther v. O'Brien Bros. Const. Co., 369 Ill. 362, 16 N. E. 2d. 890) that a sanitary district which had retained part of the fund due to a contractor for sewer construction as security for the performance of the contract could use this after the contractor's default in completing the project by the reletting of the contract, although claims for labor and materials furnished to the defaulting contractor were unpaid. Only the balance remaining after the district had paid the expense caused by the contractor's default and the cost of completing the sewers was held to be subject to the payment of such claims.



Gate house at sedimentation tank of Ashland, Ky., waterworks.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

Centrifugal Pump Performance

Centrifugal pumps can attain efficiencies over 90%, operate against pressures up to 2,000 lb. They can maintain high efficiency at varying speds; but the capacity will vary directly with the speed, the head as the square of the speed, and the power required as the cube of the speed. If the output is increased without increasing the head, efficiency will decrease. They cannot prime themselves but may carry an auxiliary primary device that starts before the pump does. A speed of 1800 rpm for a 5 mgd pump is not excessive, and small pumps are made for 6,000 rpm.[A61]

Softening at Marietta, Ohio

Marietta in 1940 put into operation a 2.8 mgd softening plant which contains four horizontal precipitators which occupy a total area of 30 x 60 ft. and 18 ft. deep. Each has a steel baffle above a cylindrical, horizontal agitator, driven by a motor equipped to give four speeds—2½, 3¼, 4¾ and 6¾ rpm. Sludge is blown off for about one minute every two hours. The total retention time in the precipitator is about 90 minutes. Immediately after precipitation, recarbonation is applied, using natural gas as source of the CO_2, which is diffused through Aloxite tubes, which are given an acid bath every three months to remove clogging. In the precipitators a sludge blanket lies definitely in the trough made by the baffle and the base of the sludge concentrator, rising slightly above the level of this concentration trough, the top of the blanket being 9 or 10 ft. below the precipitator weirs. The precipitators operate with excellent regularity, but if any change in pumpage or in chemical content upsets the sludge equilibrium it requires 4 to 8 hrs. to re-establish it.[X25]

Chlorine at Cleveland, O.

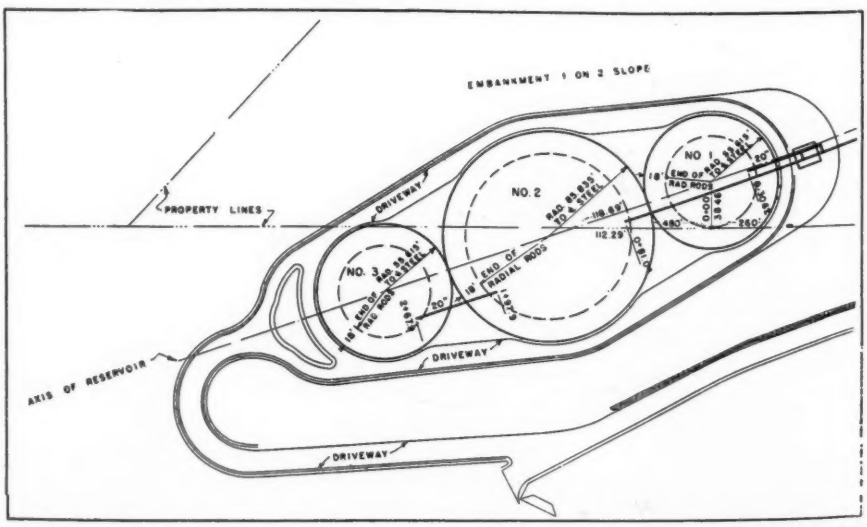
At Cleveland's filter plants, the numbers of gas-forming bacteria were not considerably reduced with rather high doses of chlorine as chloramine but were greatly reduced with straight chlorine. The germicidal velocity of chloramine treatment decreases as the temperature of the water falls; it is lower than that of chlorine at low temperatures but the two are more nearly alike at higher temperatures. Both the oxidizing potential and the germicidal value of chlorine are lowered when ammonia is applied before chlorine is added, and therefore, if at all possible, it should be applied after the chlorine has been added and had sufficient opportunity to react. However, when ammonia is used to prevent chlorophenolic tastes and odors it must be applied previous to the point of chlorine application.[X27]

Detecting Coliform Organisms

Violet red bile agar has been recommended by the A.P.H.A. for the detection of coliform bacteria in milk and has been tested at the Akron, O. water works laboratory for use with water. The conclusion was that "In addition to being nearly 10% more efficient than standard methods broth, violet red bile agar has the decided advantage of immediately giving the coli density in actual counts rather than a number that is based on a formula derived through a theory of probability, and doing it within 24 hours."[X30]

Steel-Gunite Reservoir in Syracuse, N. Y.

Syracuse in 1940 built a reservoir consisting of three steel tanks in a row, 5″ apart; the center tank 171 ft. diameter, the other two 111 ft., each 34 ft. deep. This design was due to the shape of the hill, which was such that maximum storage was obtainable on an oval area; to a desire to construct the reservoir wholly on original ground; and it gave opportunity to clean one unit with two others in service. Each tank is an all-welded steel cylinder, without a bottom, covered with mesh-reinforced gunite 2″ thick on both sides. Each cylinder rests on a ring of reinforced concrete 2 ft. wide and 6″ deep. A horizontal steel ring 1″ x 6″ was welded to the cylinder 6″ above the foundation and the reinforcing rods of the foundation were fastened in holes in this ring. The bottom of the tank is of reinforced gunite, 12″ thick at the side and tapering to 3″ in the center. Rods for



Courtesy American Water Works Assn.

Design of Morningside reservoir and high service feeders, Syracuse, N. Y.

supporting the reinforcing mesh were welded to the steel cylinder, inside and out, at 3 ft. centers and 1" from the cylinder plate. It is believed possible to grow vines clinging to the gunite surfaces of the tanks, which rise 24 ft. above the ground, and improve their appearance. The land around the reservoir is landscaped, over 10,000 shrubs and small evergreen trees being used.[A65]

Studies in Bacterial Counts

Bacteria counts give numbers of colonies rather than of individuals. If groups of bacteria could be separated before plating, the counts would be higher. The "25 vigorous shakes" of Standard Methods separate the easily separable ones but not streptococci and others. Shaken with a powerful vibrator of 60-per-second frequency, an average count of 1,459 per cc was obtained as compared to 873 for the same water by Standard Methods. Applying Calgon, 1 ppm with 15 min. contact before plating, gave 9,000 as compared to 5,500 Standard count, and 17,000 after vibration. One explanation of the Calgon effect is that it stimulates the vitality of the bacteria; another, that it is adsorbed on the bacteria and decreases the tension between adjacent surfaces.[X31]

Preventing Chlorophenolic Tastes

Tests at Cleveland, O., with use of ammonia, carbon and excess chlorine for preventing chlorophenolic tastes led to the following conclusions: "The large amounts of chlorine necessary to effect the proper sterilization of raw water and with phenol in the amount of 0.5 ppm ammonia reduced the intensity but did not prevent the chlorophenolic tastes except at very high ammonia to chlorine ratios." "Activated carbon in reasonable dosages was not effective in removing enough phenol when present in the amount of 0.5 ppm to give a taste-free water upon the addition of chlorine in the amounts of 0.36 ppm or more. Carbon removed preformed chlorophenolic tastes with reasonable dosages, but upon the addition of more chlorine the taste again appeared." "Excess dosages of chlorine proved very effective in preventing chlorophenolic tastes." "Bacterial efficiency of ammonia-chlorine is not so effective as chlorine alone in eliminating bacteria that cause growth in lactose broth, more so at the lower water temperatures."[X33]

Temperature and Softening Reactions

In warm months, total alkalinity drops much more rapidly than in cold. Tests made by cooling one set of samples in an ice bath and comparing rate of alkalinity drop with uncooled samples showed, after 15 min., an average of 96 ppm alkalinity in samples of 8.0° C average temperature and 143 ppm in samples of 2.1° C temperature. After 18 hr. 35 min. settling, the average temperatures had increased to 22.0° and 20.4° respectively and the alkalinities fallen to 65 and 78 ppm respectively. In another test, with one sample kept below 2.5° for 6 hours, while the other rose to 19.0°, the alkalinities were 132 ppm and 58 ppm respectively. "It is apparent from these tests that in order to obtain comparable results in the laboratory with a low-temperature water, the temperature of the water should be controlled close to operating conditions in the plant."[X34]

Unusual Distribution System for Small Village

Sanbornville, N. H., 500 population, recently completed a water system, the distribution mains of which include 4.3 miles of 4" to 10" steel pipe with Dresser couplings, the valves and hydrants having Dresser ends. The pipe wall has minimum thickness of 0.165 in., believed to be the least that could be tapped satisfactorily for corporation stops. To permit thawing the mains by electricity, the gaskets used with the couplings had a small helical coil of wire so embedded that it would bite through the coating on the pipe and coupling sleeve and form a good metallic contact. The corporation stops used were made specially for light-wall pipe, being provided with a copper covered rubber gasket and lock nut. Cement-lined wrought iron pipe was used for services.[F43]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Association*

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60. Population Trends in Water Supply. By C. J. Alfke. Pp. 827-836.
61. Centrifugal Pump Performance. by J. Burges. Pp. 837-843.
62. Electric Power for Water Pumping Plants. By F. I. Fairman. Pp. 844-848.
63. Maintaining Efficiency of Centrifugal Pumps. By G. J. Poole. Pp. 849-852.
64. Pumps for Small Water Works. By C. C. Walker. Pp. 853-860.
65. *c.* New Type Reservoir at Syracuse, N. Y. By E. P. Stewart. Pp. 861-875.
66. *c.* Construction of Earth Reservoir Embankments With Road Oil Linings. By D. A. Blackburn. Pp. 876-882.
67. Use of Softened Colorado River Water for Home Gardens. By O. C. Magistad. Pp. 883-893.
68. Mutual Water Companies and Domestic Water. By L. E. Blakeley. Pp. 894-902.
69. Notes on Current Corrosion Problems. By T. M. Riddick. Pp. 903-907.
70. Notes on Current Flocculation Problems. By T. M. Riddick. Pp. 908-912.
71. Bacteriological Quality of Water From Small Filtration Plants Treating Surface Waters. By H. Bosch and A. Wolman. Pp. 913-925.
72. Clogging of Rapid Sand Filters. By R. Eliassen. Pp. 926-942.
73. *t.* Measuring Low Sulfide Concentrations. By R. Pomeroy. Pp. 943-947.
74. Development of Public Water Supplies in West Virginia. By H. K. Gidley. Pp. 948-952.
75. Creston, Ia., Solves Its Water Problem. By A. K. Olsen. Pp. 953-966.
76. Investigation of Canadian Water Supplies. By H. A. Leverin. Pp. 967-971.
77. Auxiliary Water Supplies for Fire Protection. By A. C. Hutson. Pp. 972-975.

D *The Surveyor*

April 4

6. Water Sterilization: The Choice of Method. By A. Scriver. Pp. 244.

April 18

7. Internally "Sleeving" a 36" Water Main. By A. M. Moon. Pp. 267-269.

F *Water Works Engineering*

April 23

41. Well Reclaimed by Dry Ice. By R. H. Porter. Pp. 446-448.
42. Yield From Watersheds. Pp. 452-453.
43. Novel Plant and Distribution System Serve Small Village. By H. M. Bryant. Pp. 454-455.
44. *c.* Laying Submerged Pipe Line Through Ice. P. 457.

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45. Water Treatment at Charlotte, N. C. By N. N. Wolpert. Pp. 500-504.
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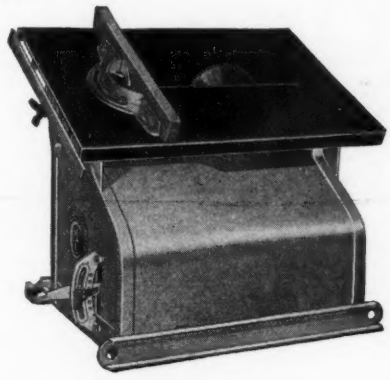
Keeping Up With New Equipment

Kost Kutter Power Saws

Construction Machinery Company, Waterloo, Iowa

The above manufacturers report enthusiastic reception of their new streamlined power saw units. Kost Kutter Sr. illustrated here has advanced vibration-proofed rubber and spring engine mounting which adds years to the life of the entire rig. It is a fast cutting, sturdy outfit — easy to transport and does the work of larger and heavier units. Convenient foot pedal pulls "Balanced" swing arbor through for cut-off work. Arbor can be locked in any desired position for ripping.

Besides the Kost Kutter Sr. with its 14″ cross-cut and 14″ rip blade. CMC also make the Kost Kutter Jr. with 10″ combination cross-cut and rip blade . . . a handy precision rig for smaller jobs of finer sawing on big jobs. Then there is the big CMC Power Sawyer with 16″ blade or optional 18″ or 20″ blades. A heavy duty rig that stands up under the toughest sawing service. New CMC catalog and special bulletin gives the entire story on this CMC Power Saw Line. Sent free by writing Construction Machinery Company, Waterloo, Iowa.



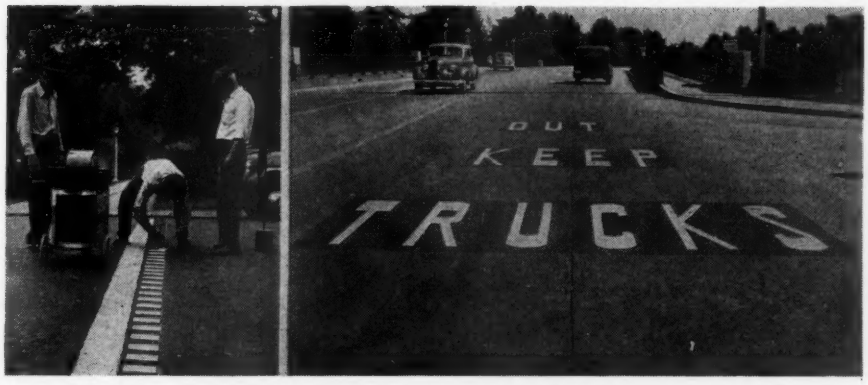
Kost Kutter Power Saw.

Permanent Traffic Markers

Armor-Flex Company
4930 Fountain Ave., St. Louis, Mo.

These markers are made of linoleum and easily applied on new or old streets or highways. Lettering is inlaid in black and white. The manufacturer claims that they have been in use for as long as 4½ years without showing any deterioration.

The engineers in one city where these markers have been used for more than 4 years states that the markers show no wear or damage from traffic or from winter frost or summer heat, and normal traffic wear keeps them polished so that they not only retain their original high visibility but also have a distinct light reflective quality. It is also claimed that the markers are proof against any stain from road oil, crankcase drippings or similar discoloring agents usually found on streets and highways. For new construction and resurfacing the markers are placed just ahead of the final rolling and are rolled in flush with the pavement. On streets and highways already in use the markers are held in place permanently by applying a hot high-melting point asphaltic mastic to the bottom of the marker which is then solidly pressed down and becomes firmly and instantly fixed to the pavement. Traffic is permitted over the markers in four or five minutes. Write the manufacturer for more complete information.



Armor-Flex linoleum traffic markers

Cotton Quilts for Curing Concrete

National Automotive Fibres, Inc.
Little Falls, N. Y.

In 1933 the Texas Highway Department and State Highway Engineer, Gibb Gilchrist, conceived that homegrown cotton might be substituted for imported burlap in curing concrete pavements and, in order to test its efficiency, some cotton mats were sent to the Bureau of Public Roads Laboratories, Washington, D. C. Detailed favorable reports on the tests were published in the July, 1933 and November, 1934 issues of "Public Roads." That department, after giving a lengthy and detailed account of the various tests made concludes with the following statement:

"With these limitations in mind, these tests substantiate the previously published conclusion to the effect that cotton mats of the thicknesses and weights shown if wet once applied with the wet side down are as effective in curing as a double thickness of burlap kept wet continuously for three days, and also that mats applied dry are less effective than either the wet mats or the burlap."

National brand cotton quilts are manufactured with covers of either new burlap or Osnaburg and a filler of cotton matting of accrued weights, stitched with parallel rows of strong thread, meeting the requirements of all state highway departments. The manufacturers claim from actual field and laboratory tests made by the numerous state highway departments, their results show that where cotton quilts were used for curing, they produced a higher compressive strength in the concrete than any other curing agents. The Federal Roads Administration have approved the use of cotton quilts for curing on all federal aid concrete paving projects.

The National brand is made by National Automotive Fibres, Inc., Highway Materials Department, Little Falls Division, Little Falls, N. Y. Complete literature including approved specifications for the use of cotton mats for curing concrete will be sent upon request.

Builders Iron Foundry Announces Change

Directors of Builders Iron Foundry, Providence, R. I., anounced that on and after May 1, 1941, the Company would conduct its metering business under the name of Builders-Providence, Inc.

It is pointed out that this is a change of name only. In fact, Builders-Providence, Inc., is a division of Builders Iron Foundry and has the same Directors and Officers.

Builders is one of the country's oldest industrial concerns—a company that

has been doing business "at the same old stand" for 121 years. While this business was started, back in 1820, as a foundry mainly to supply cast iron columns and miscellaneous cast iron hardware then being used in the construction of buildings, a machine shop was added several years before the Civil War, and since then, the company has been primarily engaged in manufacturing.

Soon after the invention of the Venturi Tube by Clemens Herschel, in 1887, Builders acquired exclusive manufacturing rights and laid the foundation for "The Venturi Meter." After 50 years of uninterrupted development in the field of instrumentation, this Company now offers not only improved Venturi Meters, but also a complete line of precision instruments for metering and controlling flow, liquid level, pressure, temperature, and weight. These include Chronoflo Electric Telemeters and Controllers, Flo-Watch Mechanical Recording Meters, Toledo-Chronoflo Automatic Conveyor Scales, Shunt Steam Meters, to mention only a few.

Builders instruments are extensively used in Industrial and Power Plants throughout the country. The Company is probably best known, however, for its specialty in furnishing complete instrumentation for Municipal Water Works and Sewage Plants.

Small Air Compressor

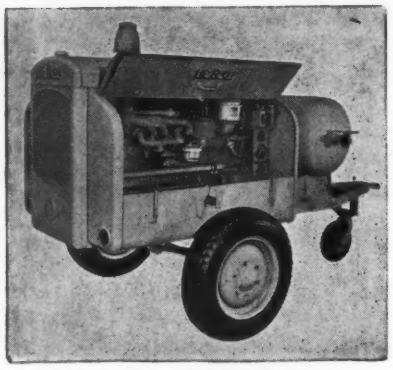
Le Roi Co., Milwaukee, Wis.

A new 60 cu. ft. portable air compressor that is extremely practical in design and operation has just been perfected and announced by Le Roi Company, 1706 S. 68th Street, Milwaukee, Wisconsin.

Answering the demand for a compressor that is light in weight, portable, and low in price yet high in value and efficiency, Le Roi Company developed this two cylinder single stage machine which may be secured on two pneumatic tired wheels, as shown, or on skids.

Speed is a feature of this model. Split-second starting is assured through the use of its own electric starting system. It is quick in the accomplishment of a job and can be transported from one location to another with remarkable speed and safety on its spring-mounted chassis and pneumatic tires.

The modern sheet steel housing offers pleasing appearance and protection from weather. Lockable hinged hood sides, when closed, cover the ample tool boxes preventing any tampering.



Le Roi Air Compressor

Included as standard equipment on the new model are the following: an exceptionally large air receiver holding 7 cu. ft., retractable caster wheel support, double-acting towing eye, mounted chassis, 4" front and rear reflectors, and large oil, gas and water capacities.

The engine driving the compressor unit is a Le Roi. Being the *only* manufacturer of *both* engines and compressors, Le Roi can build each to fit the other.

Further information is available in Bulletin 21G-1 which will be sent upon request by the manufacturer.

High-Speed Self Loading Scraper

LaPlant-Choate Mfg. Co., Cedar Rapids, Iowa

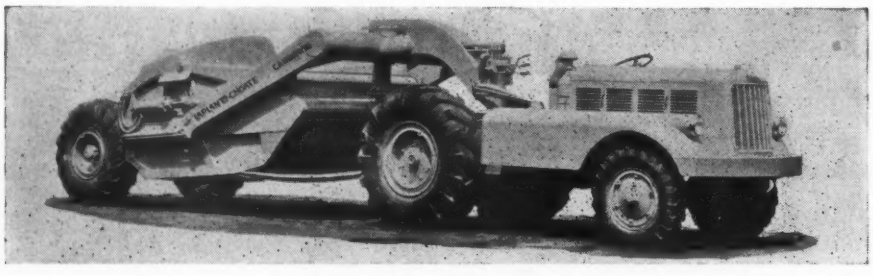
A new high-speed hydraulically operated Carrimor scraper is being made by the LaPlant-Choate Manufacturing Company, Inc., and is designed for use with the new rubber-tired Caterpillar Tractor. It loads, transports at speeds up to 18 miles per hour, and spreads earth or other material under its own power, but can be loaded by dragline or shovel, if desired.

Fingertip hydraulic control of the scraper matches the hydraulic brakes and steering of the tractor. Hydraulic rear wheel brakes on the scraper are operated simultaneously with the brakes on the tractor. A low center of gravity and correct balance eliminate bobbing, weaving, twisting, and jack-knifing.

The scientific bowed design of the cutting edge makes loading easier and faster. Improved guide arrangement insures correct operation of the rear ejector gate.

Extremely important is the honeycomb construction of the bowl bottom, an exclusive feature which means much greater strength and rigidity. Another "exclusive" is the independent apron operation. This permits uniform spreading of any material from sand to gumbo.

The unit is called the Carrimor CW-10 Scraper, and has a capacity of 8.75 cubic yards struck, and 10 yards heaped.

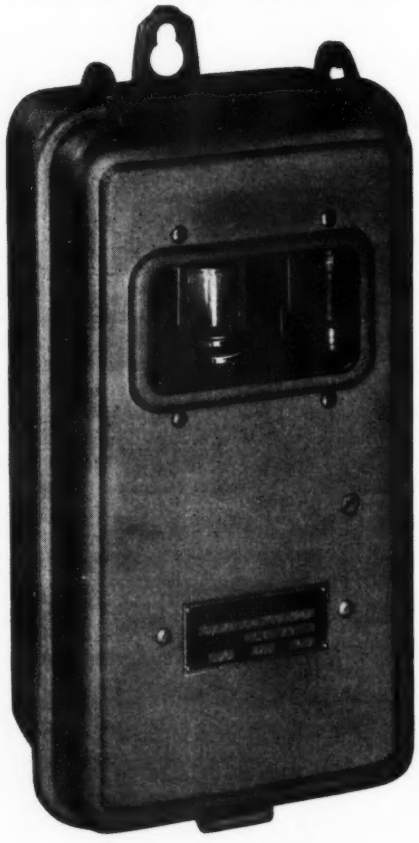


LaPlant-Choate Self Loading Scraper

The Sun-Switch

United Cinephone Corp'n Torrington, Conn.

The Sun-Switch is used to control electrical circuits in accordance with the rise and fall of natural illumination. The user chooses the two lighting levels at which he wishes the load switched on and off, and then adjusts the calibrated dials to the corresponding foot candle readings. Operation is entirely automatic, no resetting being necessary.



Cinephone Sun-Switch

Sun-Switch is primarily designed as an aid to greater safety and economy in incandescent lighting applications. Important advantages result from using the device in this service, including: (1) Lighting will always be on when needed, regardless of when darkness comes—(2) Lighting will never be on when the presence of sufficient daylight makes it unnecessary—(3) No one need be made responsible for, nor take the time to do, the job of lighting up.

Sun-Switch automatic control may advantageously be applied to: Aircraft Beacons, Airport Lights, Street and Highway Illumination. Write the manufacturer for full information.

Sewage Gas Control

By Richard C. Hall

Chief Engineer, Vapor Recovery Systems Company

Sewage disposal units today can incorporate operating gas control refinements comparable to the most highly specialized process plant installations. The Vapor Recovery Systems Company with many years experience in the gas control and safety equipment manufacture has developed a line of Sewage Disposal Plant gas control safety devices that embody the latest engineering designs.

The accompanying flow diagrams represent the latest modern sewage disposal plants; the upper diagram illustrates a Multiple Digester Unit and the lower a single Digester Unit.

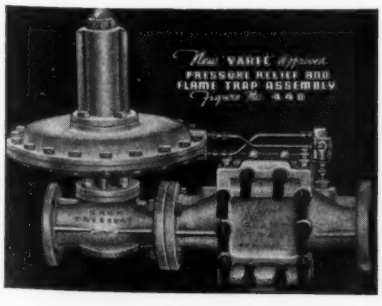
"Varec" approved equipment in these two flow diagrams has been accepted as the standard in most of the modern plants and are performing with efficiency, economy, and safety. The "Varec" Engineering Department research laboratories keep abreast with the problems in the Sewage Disposal Plants.

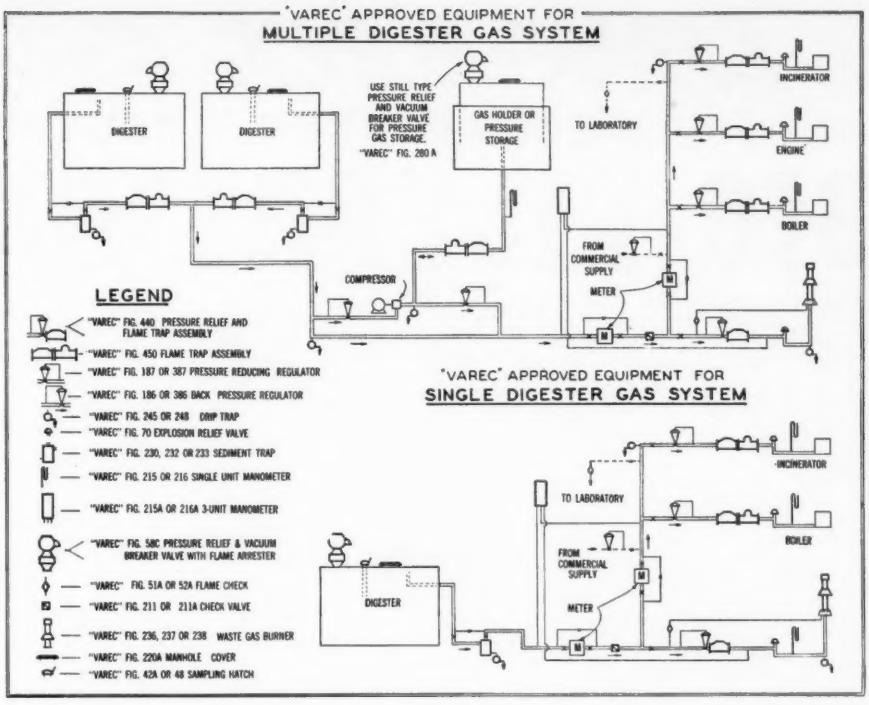
In the Multiple Digester Gas System "Varec" approved Pressure Relief and Vacuum Breaker Valve with Flame Arrester Figure 58C is installed on the digesters and gas storage tanks to maintain system operating pressure and to protect the vessels in case of fire from without. Being constructed of aluminum throughout, they are noncorrosive, easily inspected, and maintained.

"Varec" approved Flame Traps Figure 450 are installed wherever there is a possibility of fire inside the plant piping. These units are also made of corrosion resisting aluminum and afford a positive flame stop. All "Varec" Flame Arrestors are approved by the Underwriters Laboratories.

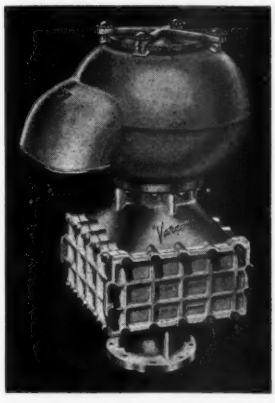
To maintain system pressure at the waste gas burner, a "Varec" Figure 440 Pressure Relief and Flame Trap assembly is installed. This unit consists of a sensitive diaphragm—operated regulating valves in conjunction with a "Varec" Flame Arrester, into which a thermally operated by-pass valve is built. In case of fire in the system, this by-pass valve automatically closes the regulating valve providing a positive flame check.

"A" series "Varec" approved Waste Gas Burners have a wide capacity range and are furnished either with or without pedestal mounting, as required. The pilot valve gas line is protected by the installation of a "Varec" approved Flame Check.





To handle sudden surges in pressure due to explosions or momentary plant fluctuations a "Varec" approved Explosion Relief Valve is installed in the system. Being dead weight loaded, it insures a positive and foolproof relief valve.



Varec Pressure Relief and Vacuum Breaker Valve with Flame Arrester

In plants where the gas is used to operate boilers, engines or other equipment, a "Varec" approved Pressure Regulating Valve is installed in the gas line to each piece of equipment. These valves are set to operate at a lower pressure than the "Varec" Figure 440 Pressure Relief and Flame Trap unit, thus making sure that all the gas required is available for useful work before any is allowed to go to the waste Gas Burner.

"Varec" Manometers are used through the plant for indicating system pressure and are available in single or triple reading units with or without push button control.

One of the basic designs fundamental in gas plant engineering is to keep the lines drained and free from moisture. A full line of "Varec" approved Sediment Traps and Condensate Drip Traps are available to meet this requirement.

The "Varec" Check Valve is required in a system operating at low pressure. Its aluminum clapper cuts down the pressure required to keep it open.

"Varec" Figure 220A non-sparking and gas tight Manhole Covers, installed on all tanks, provide a quick entry into the tank.

"Varec" Gauge and Sampling Hatches are also gas tight and non-sparking and have a foot pedal design to facilitate taking samples and gauges.

"Streeemline" Meter to Be Shown at Toronto

The National Meter Division of the Pittsburgh Equitable Meter Company will exhibit the Empire "Streeemline" Meter for the first time at the Toronto Convention of the American Water Works Association. The trade name, "Streeemline," has been chosen to describe the smooth flow lines and unexcelled accuracy and head-loss curves. The manufacturer announces that the "Streeemline," a four-bolt, frost protected meter, is a thoroughly modernized version of the well known National Empire Water Meter. It further states that this product embodies the same basic principle of oscillating piston measurement that has been time proven in hundreds of thousands of Empire Meters.

Due to the scientific design and proportion of the measuring chamber, with dual inlet and outlet ports, the accuracy claimed for this meter is said to be even superior to that of Empire Meters built in the past.

Extremely compact overall dimensions, made possible by a reduction in

(Continued on page 71)

LINK-BELT *Sludge Collectors*

ASSURE BEST RESULTS FROM

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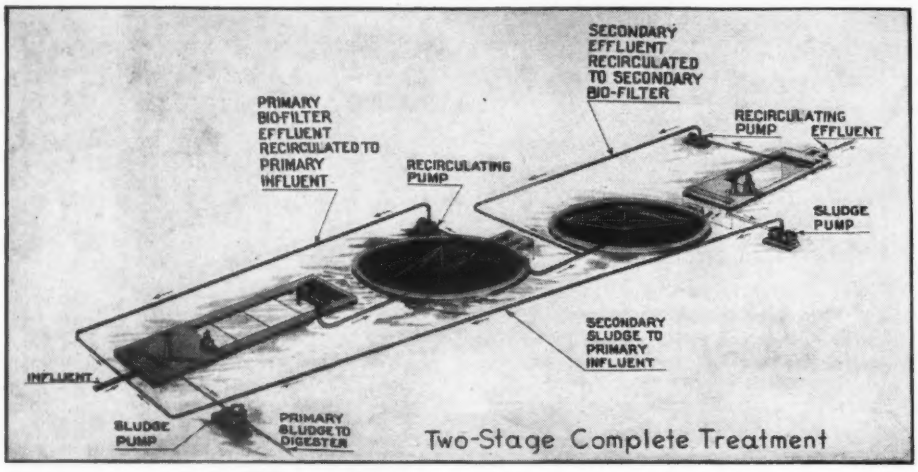


Two-Stage Complete Treatment

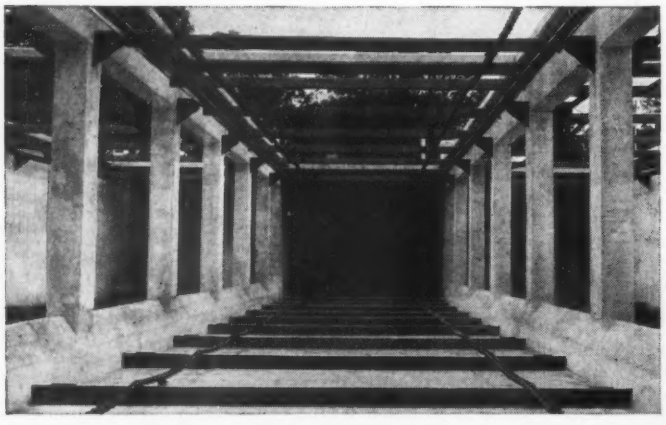
● Much of the effectiveness of this system depends on the reactions between the filter effluent and the raw or partly treated sewage in primary and secondary detention tank or tanks. Rectangular tanks equipped with Link-Belt STRAIGHTLINE collectors and circular tanks with CIRCULINE collectors for larger installations, are ideal for use with this process. Many Bio-filtration plants now in service are proving the efficiency of Link-Belt Collectors with this system. Send for Special Folder PW-1881.

SINGLE-STAGE COMPLETE TREATMENT

This treatment consists of primary settling, biological treatment in a sprinkling filter and secondary settling. Part of the flow from the filter is returned to the primary tank influent. The sludge from the secondary settling tank can be returned to the primary influent or go direct to the digestion tank. The B.O.D. of the effluent from the secondary tank is generally equal to that of a standard filter.

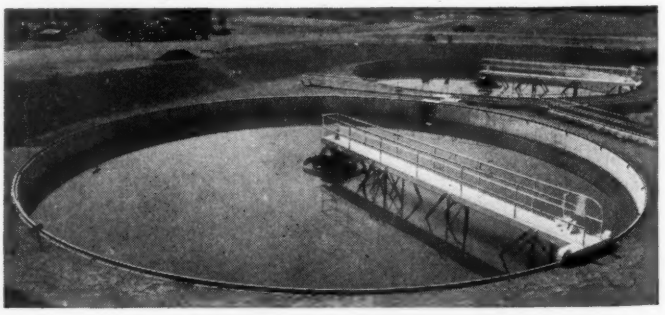
TWO-STAGE COMPLETE TREATMENT

This treatment has primary settling, series filtration and secondary settling. The effluent from the primary filter and the sludge from the secondary tank is returned to the primary tank. Part of the effluent from the secondary tank is recirculated to the secondary filter. This arrangement has exceptional flexibility, and strong domestic sewage or trade wastes can be successfully handled by such a plant.



← STRAIGHTLINE COLLECTORS

Link-Belt STRAIGHTLINE Sludge Collectors for the removal of sludge from rectangular settling tanks consist of two strands of especially processed malleable chain from which are suspended at uniform intervals scraper flights usually made from red wood. Features are peak-cap bearings, pivoted flights, cross collectors for larger tanks, and positive sludge removal at a slow, uniform speed. Automatic or semi-automatic skimming equipment is furnished when required. Send for Book No. PW-1742.



CIRCULINE COLLECTORS →

Link-Belt CIRCULINE Collectors for the removal of sludge from round tanks consist of a flight conveyor suspended from a bridge, one end of which is pivoted at the center and the other travels around the circumference of the tank. Features are positive slow uniform speed, positive sludge removal and excellent distribution of flow throughout the tank. Automatic skimming is furnished when desired. Send for Book No. PW-1642.

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PEOPLE . . . Here and There

Highway Defense Needs Total $808,000,000

War and Navy Departments Certify 288 Areas Where Access Roads Are Needed at Once; 50 More Expected Soon; Congress Is Awaiting Administration Recommendations

Latest estimates from the U. S. Public Roads Administration show that $808,000,000 is needed immediately for defense highways. Of this total, $458,000,000 is required to correct deficiencies in the strategic system of military highways and $350,000,000 for construction of access roads in defense areas.

As an example of the need for quick action, Commissioner McDonald cites Camp Leonard Wood, Missouri, where daily traffic on one road leading from the main highway to the camp has increased from 200 vehicles to 12,000 vehicles, or 60 times.

The network of roads of principal military importance, referred to as the strategic system, includes approximately 75,000 miles. Commissioner MacDonald said that there are more than 5,000 miles of these existing strategic roads that need widening; nearly 2,500 bridges, and approximately 14,000 miles of roads that need strengthening.

A Congressional committee has given consideration to the defense roads situation and is ready to prepare a bill for introduction in Congress but is reported to be awaiting definite recommendations from the Administration.

R. S. Bubb Heads New Jersey Industrial Marketers

Robert S. Bubb, Advertising Manager of Lock Joint Pipe Co., Ampere, N. J., has been elected President of Industrial Marketers of New Jersey.

Mr. Bubb, a graduate of Yale, 1932 (Sheffield), has been in the advertising business since leaving college, having preceded his present position with several years experience in the General Electric Co.

Frost Action Studies Continue

Since 1938, investigations have been under way at Purdue University to determine the effects of admixture treatment on frost action in different soil mixtures, and on the migrating characteristics of chemicals used for treating the soils. The work is being conducted by the University's Engineering Experiment Station in cooperation with the State Highway Commission of Indiana. A 1940 progress report on the

Floyd O. Slate

studies revealed that as long as the soil mixtures tested retain the calcium chloride in full concentration, two per cent or less chemical prevents freezing at minus 10 to minus 15 degrees F. and thereby prevents frost damage.

To carry these investigations further, the Calcium Chloride Association has recently established a fellowship at Purdue University with the object of studying (1) the minimum amount of calcium chloride necessary to prevent appreciable frost heaving in different types of soils subject to varying temperatures, (2) the degree of permanency of chemical treatment under various conditions, and (3) the relative effectiveness of different methods of applying the chemical. The study will include both field and laboratory investigations.

Floyd O. Slate, a graduate of Purdue's School of Science who majored in analytical chemistry, has been selected as the Research Fellow and will conduct the program under supervision of K. B. Woods, Assistant Professor of Highway Engineering.

Dr. C. F. Rassweiler Appointed J-M Director of Research

The appointment of Dr. C. F. Rassweiler as Director of Research of Johns-Manville Corporation was announced Tuesday (May 22) by Lewis H. Brown, President of the Corporation. Dr. Rassweiler has been director of the Philadelphia laboratory of E. I. duPont de Nemours Co.

In his new position Dr. Rassweiler will be a member of the Officers Board in charge of Johns-Manville's extensive research activities on which the company is spending close to a million dollars annually. About 200 research scientists, engineers and assistants are employed in the J-M Research laboratories located at the company's largest plant in Manville, N. J.

Mr. Brown, in making the announcement, pointed out that more than half of Johns-Manville sales today come from products which have been added by the company's research, development and expansion program of the last twelve years, and that appointment of the new research director is made in preparation for increased activity in product improvement and new development. During the present national emergency in which more than a third of all J-M production is going into national defense, new problems facing the research organization arise daily, Mr. Brown said, particularly as the company tries to anticipate possible shortages in raw materials and to develop suitable substitutes.

War Department Retains Engineers

The War Department has awarded contracts to engineers for making surveys and preparing plans for nine additional cantonments for triangular divisions. This does not mean that the camps will be constructed, as this must wait action by congress. But it does mean that plans and specifications will be prepared and made ready for immediate construction if necessary. The camp sites and the consulting engineers are as follows:

Blackstone, Va., Wiley & Wilson; Columbus, Ind., Chas. Hurd; Augusta, Ga., J. B. McCrary Engr. Co.; Cookson Hills, Okla., Holloway & Cochrane; Neosho, Mo., Burns & McDonnell; Ft. Smith, Ark., Black & Veatch; Santa Maria Ranch, Calif., Leeds, Bernard & Jewett; Eugene, Oregon, John W. Cunningham & Associates & Lawrence & Allyn; Medford, Oregon, Blackie & Wood & Myron Hunt & H. C. Chambers.

New Appointments

New City Engineers recently reported include:

Al. Greer, Fayette, Ala.
L. Harold Anderson, Palo Alto, Calif.
E. L. Long, City Manager, Porterville, Calif.
L. L. Lee, City Manager, Miami, Fla.
Paul E. Rossiter, Dubuque, Ia.
Patrick J. Foley, New Bedford, Mass.
Innis Ward, Duluth, Minn.
H. C. Holz, Kirkwood, Mo.
William A. Good, Laurel, Mont.
Arnold J. O'Mara, Laconia, N. H.
W. R. Wooten, Tulsa, Okla.
Ray E. Schoffstall, City Mgr., Boyertown, Pa.
M. L. Smith, So. Williamsport, Pa.
Geo. T. Wilson, Supt. Public Wks., Lebanon, Tenn.
J. W. Crooks, Town Mgr., Franklin, Va.
Jerod W. Day, Ashland, Wis.

New Water Works Superintendents are:

Ivan T. Jacks, Jasper, Ind.
Luke Haines, Bay City, Tex.

The following are new county engineers:

L. G. Smith, Madison Co., Huntsville, Ala.

(Continued on page 70)

Readers' Service Department

These booklets are FREE. Use the coupon below or write the manufacturer direct, mentioning PUBLIC WORKS.

Construction Materials and Equipment

Bituminous Mixer

7. Exact control by volumetric proportioning. Continuous mixing and large capacity. The Barber-Greene mixer can be used as a unit of a travel plant or as a central plant. Excellent and instructive. Well illustrated book on request. Barber-Greene Co., Aurora, Ill.

Cold Mix Plants

10. New catalog and prices of Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subject suggested by title.

31. New 48-page booklet in five sections explains clearly the effects, advantages and methods of using Calcium Chloride and Portland Cement mixes. Complete and packed with practical information; well illustrated; pocket size. Sent free on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

33. Pocket manual of concrete curing with calcium chloride. Complete, handy. Contains useful tables, well illustrated. Write the Columbia Chemical Division, Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, N. Y. C.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Concreting in Winter

47. "Build Straight Through the Cold Weather Season" explains briefly how to obtain satisfactory winter concrete in less time. Write Michigan Alkali Co., 60 East 42nd St., New York, N. Y.

Drainage Products

70. Standard corrugated pipe, perforated pipe and MULTI PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses are described in a 48-page catalog entitled "ARMCO Drainage Products," issued by the Armco Drainage Products Association, Middletown, Ohio, and its associated member companies. Ask for Catalog No. 12.

71. Modern Culvert Practice — a 72 page book containing valuable data and tables will be sent promptly to anyone interested in drainage by Gohi Culvert Mfrs., Inc., Newport, Ky.

Mud-Jack Method

107. How the Mud Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities — a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Bituminous

111. An excellent booklet issued by The Barrett Co., 40 Rector St., New York, N. Y., describes and illustrates the uses of each grade of Tarvia and Tarvialithic; 32 good illustrations.

Paving Materials, Brick

116. "New Developments in Brick Pavements." A review of the developments in brick pavements in recent years. Issued by the National Paving Brick Association, National Press Building, Washingon, D. C.

Pumps

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

122. CMC pump bulletin illustrates and describes complete line of modern centrifugals made in sizes from 1½" to 10" by Construction Machinery Co., Waterloo, Iowa.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16-page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from ½" to 8", including lightweight models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

Retaining Walls

126. Charts showing the design of cellular or bin-type metal retaining walls, helpful suggestions on their use for stabilizing slopes, preventing stream encroachment, and solving problems of limited right of way, and construction details are given in a 16-page bulletin entitled, "ARMCO Bin - Type Retaining Walls." It is published by the Armco Drainage Products Association, Middletown, Ohio, and member companies. Ask for Bulletin H-37.

Road Building and Maintenance

127. See road work as it was done in the 1890's and as it can be done by a full line of this year's road building equipment. See, in this new action picture book, the first reversible roller, 1893 World's Fair Award Grader and how methods have changed. Attractive new booklet AD-1796 recently issued by The Austin-Western Road Machinery Co., Aurora, Ill.

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalogs Nos. 253, 254 & 255, issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

129. New bulletins illustrate and describe the latest line of Littleford Utility Spray Tanks, Street Marking Units, Street Flushers and Kettles. Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

130. Toro patching rollers, tractors and mowers for parks, airports, estates, highways and golf courses are pictured and detailed in new illustrated booklet available from Toro Mfg. Co., Minneapolis, Minn.

Rollers

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

138. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

139. "Ironeroller" 3 Axle Roller for extra smooth surfaces on all bituminous work. Booklet contains roller data and operation details. Hercules Co., Marion, Ohio.

Spreader

147. Jaeger Paving equipment, including Mix-in-Place Roadbuilders, Bituminous Pavers, Concrete Bituminous Finishers, Adjustable Spreaders, Forms, etc.— 4 complete catalogs of latest equipment in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set forth the principals and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

152. The Columbia Alkali Corporation, will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing Columbia Alkali Div., Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, New York City.

154. "Soil Stabilization with Tarvia" —An illustrated booklet describing The steps in the stabilization of roadway soil with Tarvia will be mailed on request by The Barrett Company, 40 Rector St., New York, N. Y.

Tractors

159. "International Diesel TracTracTors," is a 48-page catalog giving full details of TracTracTors, including action pictures with bulldozers, bullgraders, blade graders, wheel scrapers, elevating graders, etc. Sent promptly by International Harvester Co., 180 North Michigan Ave., Chicago, Ill.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

199. Aeroil "Heet-Masters" for quick heating and melting of tar, pitch, asphalt, etc., with less fuel are illustrated and explained in new catalog No. 196W issued by Aeroil Burner Co., Inc. Box 599, West New York, N. J.

USE THIS COUPON

6-41

Readers Service Dept.
PUBLIC WORKS
310 East 45th St., NEW YORK

Please send me without obligation the following booklets listed in your READERS' SERVICE SECTION .....
(indicate by numbers)

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City ..... State .....

(Continued from page 68)

Paul Hensley, Cobb Co., Marieta, Ga.
Leland E. Robinson, White Co., Carmi, Ill.
Ray V. Hauck, Ottawa Co., Minneapolis, Kan.
O. Z. Goode, East Carrol Parish, Lake Providence, La.
Cornelius Van Zelfden, Madison Parish, Tallulah, La.
Harry V. Jones, Wicomico Co., Salisbury, Md.
J. Bruce Orr, Broome Co., Binghamton, N. Y.
D. T. Meldrum, Clackamas Co., Oregon City, Ore.

Dealers Appointed

Among the distributors recently appointed by The Hercules Company, Marion, Ohio, for its *Ironeroller* are: The Petrie Machinery Co., 501 No. Broadway, Billings, Mont., H. P. Kelly Equipment Co., 2101 Florence Ave., Cincinnati, Ohio, and The Empire Equipment Co., 824 No. Main St., Sioux Falls, S. D.

Bullgrader and Bulldozer Bulletin

Everything you want to know about Bucyrus-Erie's new line of Hydraulic Bullgraders and Bulldozers for International TracTractors is contained in their 24-page Bulletin No. BGD-6 just published. Sixty photographs, plus drawings and diagrams "tell all" about construction details and design features. Actual field action shots tell the story of features turned into performance on the job.

Complete specifications on Bullgraders and Bulldozers for International TracTractors TD-6, TD-9, TD-14 and TD-18 are given in the bulletin, copies of which may be obtained by writing to PUBLIC WORKS, or directly to Publicity Department, Bucyrus-Erie Co., South Milwaukee, Wisconsin.

Radio Communication, Two Way

250. Valuable information on how cities and towns all over the country have solved their radio communication problems is found in "Motorola Radio Communication Equipment." Write Galvin Mfg. Corp., 4545 West Augusta St., Chicago, Ill.

Sprayers

280. Cutback sprayers with new "single unit safety control" and full control of all spraying operations from the nozzle are described and illustrated in new bulletin No. 190 W issued by Aeroil Burner Co., Box 599, West New York, N. J.

Street Markers

300. Street marking simplified by the use of modern, self-contained units capable of handling any kind of striping jobs is the subject of an illustrated bulletin giving also full details of new M-B Street Markers. Sent by Meili-Blumberg Corp., Box PW, New Holstein, Wis.

Snow Fighting

Plows

349. "V-type Plows for Motor Trucks" is a handsome new 24 page catalog illustrating the wide variety of models and many special features of Frink Sno-Plows and leveling wings. Tells how to select the proper plow for your trucks. Write Carl H. Frink, Mfr., Clayton, N. Y.

Ice Control

351. "Make Icy Highways Safe for Traffic"—a new bulletin by Michigan Alkali Co., 60 East 42 St., New York, N. Y., tells how to use calcium chloride for modern ice control.

Sanitary Engineering

Activated Alum

354. "Technical Data on Activated Alum and Dustless Blackalum" points out the analytical side of Activated Alum and Blackalum. Write Activated Alum Corp., Curtis Bay, Baltimore, Md.

Aero-Filter

356. New illustrated bulletin gives complete information on design of Aero-Filters to provide high-capacity, uniform, raindrop application over the entire filter bed. Write Lakeside Engineering Corp., 222 West Adams St., Chicago, Ill.

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

376. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Cleaning Mains

381. "Let's Look Into the Matter of Water Main Cleaning" is an illustrated booklet outlining the advantages of water main cleaning and explains how it can be done quickly and inexpensively by The National Method. Write National Water Main Cleaning Co., 30 Church St., New York, N. Y.

382. "Reconditioning Large Water Mains" and "Cement Linings of Large Diameter Mains in Place" are two interesting pamphlets available from Centriline Corp., 140 Cedar St., New York, N. Y.

Cleaning Sewers

383. A 20-page booklet describes and illustrates a full line of sewer cleaning equipment—Rods, Root Cutters, Buckets, Nozzles and Flushers. Write W. H. Stewart (Pioneer Mfr. since 1901), Jacksonville, Fla., or P. O. Box 767, Syracuse, N. Y.

Corrosion Prevention

384. Enamels and coatings to protect pipe lines, sewage plant structures and equipment against corrosion. Recommendations for any problem. Wailes Dove-Hermiston Co., 17 Battery Place, New York, N. Y.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. % 96 Codding St., Providence, R. I.

Filter Bed Agitator

388. 60-page booklet, "The Mechanics of Filter Bed Agitation," containing engineering data, technical information concerning surface wash and opinions of users will be sent promptly by Activated Alum Corp., Curtis Bay, Baltimore, Md.

Filter Plant Controllers

389. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Fire Hydrants

390. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Anniston, Ala.

391. See listing No. 410.

Flow Meters

393. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others — and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Gates, Valves, Hydrants

394. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Anniston, Ala.

395. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

396. See listing No. 410.

Hypochlorinators

400. New illustrated booklet W&T 357 describes this simple, inexpensive means of protecting small water supplies such as summer camps, hotels, swimming pools, dairies, etc., as well as for feeding chemical solutions in the water works plant. Contains typical installation sketches. Write "Wallace & Tiernan Co., Inc., Newark, N. J.

Manhole Covers and Inlets

402. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend, Ind.

Manhole Cover Silencers

403. New bulletin on Tapax for quickly ending noisy manhole covers and small sample free. Write Tapax Mfg. Co., 201 Hoyt Ave., Mamaroneck, N. Y.

Meters, Venturi

405. MS Meters for use with venturi tubes, flow nozzles, etc., in wall, panel, or floor mounting are covered in detail in catalog sent free by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

406. New bulletin illustrates Builders Air Relay system of transmission for the Venturi Meter which is particularly useful for liquids containing suspended solids like sewage. Eliminates corroson, clogged pipes, etc. Write Builders Iron Foundry, Codding St., Providence, R. I.

Meters, Water

407. Complimentary bulletin W529 tells all about Pittsburgh IMO water meters, "the meters that wear in where others wear out." Write Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

Pipe, Cast Iron

408. Handbook of Universal Cast Iron Pipe and Fittings, pocket size, 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., 386 Fourth Ave., New York, N. Y.

409. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Burlington, N. J.

410. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe, Reinforced Concrete

412. Literature describing the manufacture and installaton of Lock Joint Reinforced Concrete Pressure Pipe for water supply lines and sewer force mains. Lock Joint Pipe Co., Ampere, N. J.

Pipe, Transite

413. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., 22 East 40th St., New York, N. Y.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pipe, 2-inch Cast Iron

417. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis, Tenn.

Meter Setting and Testing

430. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Recarbonation

431. Bulletin describes stabilizing lime-softened water by recarbonation, discussing gas production, washing, compressing, drying, and applying the CO(2). International Filter Co., 325 West 25th Place, Chicago, Ill.

Sand Expansion Indicator

432. New bulletin gives full details of Simplex Sand Expansion Indicators for water plants. Write Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

434. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.

Steel Sheet Piling

435. Steel sheet piling to speed sewer jobs is covered in illustrated catalog containing complete production specifications. Write Dept. PW-2, The Union Metal Mfg. Co., Canton, Ohio.

437. "Metal Sheeting for Lower Average Job Costs" is a new bulletin about light weight sheeting you can use again and again. Issued by Armco Drainage Products Assn., Middletown, Ohio.

Septic Tanks, Small

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip Inc., 504 E. Glen St., Syracuse, N. Y.

Sludge Drying and Incineration

440. "Disposal of Municipal Refuse." Complete specifications and description including suggested form of proposal; form of guarantees; statements and approval sheet for comparing bids with diagramatic outline of various plant designs. 48 pages. Address: Morse Boulger Destructor Co., 216-P East 45th St., New York, N. Y.

441. Full information about Nichols modern, efficient gabage and refuse incinerators now available in the Basket Grate, Continuous Grate, Revolving Grate and Monohearth types will be sent promptly by Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

442. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

443. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes — a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

Swimming Pools

446. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

447. 40-page Manual on swimming pools. Includes swimming and pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Taste and Odor Control

450. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination, a method of discovering the point at which many causes of taste may be removed by chlorination with little or no increase in residual chlorine. Sent free to any operator requesting it.

Treatment

453. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

455. New booklet (No. 1642 on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

456. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewarage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

457. New illustrated folder (1942) on Straightline apparatus for the removal and washing of grit and detritus from rectangular grit chambers. Address: Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

458. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, 570 Lexington Ave., New York, N. Y.

459. A combination mechanical clarifier and mechanical digester, The Dorr Clarigester, is explained and illustrated in a bulletin issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

460. This new 145 page illustrated chemical products book contains 55 pages of Tables, Factors and valuable Reference Data. Issued by General Chemical Co., 40 Rector St., New York, N. Y.

461. Prefloccculation without chemicals with the Dorrco Clariflocculator in a single structure is the subject of a new booklet issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

462. Dorrco Monorake for existing rectangular sedimentation tanks, open or closed, is described and illustrated in a new catalog sent on request. The Dorr Co., 570 Lexington Ave., New York, N. Y.

Valves (See Gates, Air Release, etc.)

(Continued from page 65)

Empire "Streeemline" Meter

the number and size of interior castings, is one of many outstanding features. All working parts are fitted as a complete unit, without use of screws, before being inserted in the outer case.

Complete frost protection is claimed for this meter. The cast iron bottom plate, protected against corrosion with a coat of Resistin, is designed to break in event of freezing. Since both the measuring chamber and the enclosed intermediate gear train housing utilize snap joint construction, without screws, the parts will separate when the frost bottom plate breaks, thereby giving protection to the working parts against damage or distortion. It is claimed that this design provides the first fully frost protected gear train.

Literature completely describing this new Meter will be sent to those writing to the National Meter Division, Pittsburgh Equitable Meter Company, 4207 First Avenue, Brooklyn.

A 97 hp Engine Now Standard for GMC 2-Ton Trucks

General Motors Truck & Coach Co.
Pontiac, Michigan

Announcement has just been made by General Motors Truck and Coach of a new 97 horse power engine, offered as standard equipment in all 2-ton GMC Trucks, and also available at slight additional cost in GMC 1½-ton models.

According to information released by the factory, GMC's new engine has a displacement of 236 cubic inches, developing 97 horse power at 3,200 r.p.m., and 192.5 lbs. ft. torque at 1,000 r.p.m. It is claimed that this engine offers greater torque or pulling power than any other engine of its size in the light duty truck field.

The high torque of this latest "super duty" engine to join the ranks of GMC's valve-in-head engine line has been attained through development of a high-lift cam—with properly coordinated engine timing — which permits a more complete utilization of the high power and economy advantages claimed as inherent in GMC Turbo-Top piston and combustion chamber design.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Total Defense for Swim Pools

Bulletin TTT just issued is a valuable treatise on the dangers of disease transfer through swimming pools, bathing pools, therapeutic pools, shower rooms, foot baths, etc., and how to prevent that danger. It explains the "Two Time" treatment which the manufacturer claims is the latest development in swim pool sanitation.

Everyone in charge of swim pools should have a copy of this interesting and instructive bulletin. Write %Proportioneers, Inc.%, 9 Codding St., Providence, R. I.

An Instructive Bulletin on Water Treatment

In Bulletin No. 103 this organization explains what ozone does and describes the equipment which is scientifically designed to generate ozone with a low energy consumption previously unavailable. Copies available upon request. Ozone Processes, Inc., 1500 Walnut St., Philadelphia, Pa.

Odor Control in Sewage Plants

This is the title of an informative folder showing how Preventive Chlorination is being used successfully for eliminating odors in a large number of sewage disposal plants. The information given in this folder is well worthwhile. Write Wallace & Tiernan for a copy.

Oxy-Acetylene Welding and Cutting Equipment

A new 12-page, illustrated booklet, "What the Purchasing Agent Should Know About Oxy-Acetylene Welding and Cutting Equipment and Processes," has just been announced by The Linde Air Products Company. The booklet is designed to help the user or prospective user obtain a clear understanding of the oxy-acetylene process and the various construction and operating features of welding and cutting apparatus used in applications of the process.

Copies of this booklet, Form 4694, can be obtained without cost by writing The Linde Air Products Co., 30 East 42nd St., New York, N. Y.

Gar Wood Industries' Detroit, Mich., Issue New Bulletins

Bulletin No. 7 illustrates and describes Gar Wood hoists and dump bodies for 1½-2 ton trucks; No. 16 illustrates and describes hoists and dump bodies for Ford trucks and No. 17 illustrates and describes hoists and dump bodies for Chevrolet trucks. Copies available upon request.

Index to ADVERTISEMENTS